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Sculpture and Ideas

"Mask" (wood and raffia), Republic of the Congo, Bapeńde Tribe. Photographed by O. E. Nelson. *Courtesy of Mr. and Mrs. Henri Kamer, New York.*

MICHAEL F. ANDREWS
Syracuse University

Sculpture and Ideas

. . . for school and camp programs

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Preface

It is the purpose of this book to convey the true nature of sculpture, to attempt to foster an understanding and appreciation of modern sculpture, and to encourage a partaking in sculptural experiences. The book should not be misconstrued as a textbook, but rather as a reference and guide which concentrates largely upon the simple techniques of the various sculptural processes. Its nature is progressive in character, ranging from the simple but most important beginnings of preschool experiences to the more complex impressions of the mature and professional sculptors.

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Great sculptors, however, are born in the hearts and minds of the very young. Their encounter with a world of their own reality, experiences of dimensions, and continual discovery of the new wonders of existence are the first steps in a scholarly study of sculpture. These experiences represent the aesthetic worth from which the individual builds values he later intuitively uses for reference. Against such values the experienced sculptor senses the quality of his immediate experience. In this respect, although it deals primarily with sculpture of the elementary and secondary schools and adult beginners, the book is more than a guide to the first step in sculpture. It is an enlightenment to anyone who hopes to understand the whole of sculpture and especially to those who plan to teach sculpture to others.

The author's intentions are to expose the reader to a variety of technical processes and new ideas from which may stem, in his own teaching, a wider range of sculptural experiences. The real understanding and appreciation of sculpture is possible only to those who make of it a living influence. Teachers of sculpture should be cognizant of the early prerequisites from which sculptors are made and should seek the continuitive practice of sculpture.

This book deals with the principles of sculpture. To carve or cut out of wood, stone, or any other dense substance is, in reality, the only process to which the term *sculpture* logically applies. But today the all-inclusive field of three-dimensional art is included in its current interpretation. The term may be applied to clay modeling; the carving of wood, stone, or some other plastic substance; welding images in steel; and constructing and assembling an array of materials. The sculptural processes will be discussed in three separate parts: modeling, carving, and constructing. There is a fourth consideration which shall be referred to here as *applied sculpture*. It is primarily concerned with the designing of practical or utilitarian forms such as pottery, puppets, jewelry, architecture, and industrial design products. A few of these will be referred to in the form of illustrations and run-arounds.

The factual information contained herein must be supplemented with actual sculptural experiences if the individual is to gain a sense of space, time, and volume. It is, therefore, the author's hope that the reader be motivated to try his hand at sculpture. Furthermore, it is the author's desire that after this initial introduction to sculpture the reader may have become fascinated with and more aware of the creative possibilities and values in sculptural experiences.

Throughout the years I have drawn heavily upon the experiences of many persons associated with the creative process, and to them I am deeply indebted. I am also grateful to the staff of Prentice-Hall without whose cooperation this publication could not have been realized; to Anna McPheeters, Carol Viney, and my wife, Helen, who diligently and patiently typed and retyped the manuscript; to my daughter Judi for her grammatical suggestions; to those who have contributed illustrations—the young children, high school and college students, and adult amateurs whose names of necessity have been omitted, and to the teachers, professional artists, art galleries, and museums that are acknowledged throughout the text. Special acknowledgement is rendered to those who, believing in sculpture enough to have practiced it, left a rich heritage which substantiates its very existence and symbolizes its values throughout the history of man.

M. F. A.

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Sculpture and Ideas

Introduction

What is sculpture? What is its purpose? What is its role in the lives of men? Perhaps through our answers to these questions sculpture can be more fully comprehended. For teachers not closely aligned with sculpture but responsible for its existence in art programs, a definition may help to serve as an effective springboard to broader understanding.

As we seek for a definition we find that sculpture is many things to many people. For the very young it may be something made of clay, or a puppet or a statue. To those

who are a little older it may mean objects you can see and touch and walk around. To the average person the term may evoke an image of a human figure carved in wood or stone. A banker once said to me that he thought it to be the relief images on coins. To a soldier it may signify a monument. To the more mature and sophisticated mind, sculpture is a substitute for reality; it stands for something or somebody. Malvina Hoffman defines it as a "parable in three dimensions, a symbol of a spiritual experience, and a means of conveying truth by concentrating its essence into visible forms."[1] To still others it is any practical, three-dimensional form: architecture, ceramicware, a piece of jewelry, or some other utilitarian product.

Although definitions alone cannot expound its essence, they do at least give a fair picture of the diverse syntax of sculpture throughout the ages. Perhaps it can best be comprehended through an intimate knowledge of its reason for being. The significance of sculpture may vary considerably but its basic *raison d'être* remains the same. It reflects the characteristics of the life, habits, and beliefs of a people. By taking a katchina doll of the Hopi Indians, a brass tray with a geometric pattern of stars in parallel lines typical of Saracenic Art, and a Catholic image of Santa Barbara of Brittany, Vogt clearly illustrates this point. "You can take up one of these little objects," says Vogt, "and describe almost offhand the main characteristics of the life from which it came, as a scientist reconstructs some old dinosaur from one of the fossil bones. You could conjure, for instance, the whole structure of fatalism in philosophy, despotism in government, the abstract decoration, the polygamy, and everything else from beggar to caliph that belonged in the same world with the little piece of brass: also the faiths,

[1] Malvina Hoffman, *Sculpture Inside and Out* (New York: W. W. Norton & Company, Inc., 1939), p. 19.

feelings, institutions, and customs that belong with the description of the universe of which the others are symbols."[2]

The Cora Indian of Old Mexico, for example, believed that he could destroy his enemy by making a crude likeness of the victim out of burnt clay or strips of cloth and bits of leather, and while uttering incantations, run thorns through its head or stomach. Although Cora Indians commonly used sculpture for the spiteful purpose of putting obnoxious people out of the way, they also, but more rarely, employed sculpture for beneficial purposes. They multiplied their flocks and herds by modeling, in clay or wax, images of the animals they wanted, or they carved them from tuff and deposited them in a sacred cave. They looked upon the mountains as the master of all riches and upon sculptural images as the means of satisfying their needs. It was imperative that the images they fashioned be likenesses of their desires.

As far back as the Paleolithic Age, man evolved sculpture as a result of his desire to have control over the forces of nature. Presumably, the small stone figures of Venus of Willendorf were basically symbolic of fertility and designed to perpetuate the race. Roman sculpture, on the other hand, was designed to commemorate the heroic deeds of its people. The Egyptians used sculptural images to represent their departed loved ones for whom they sought an abode for the soul. They also fashioned small *Ushabti,* figures that were placed in the tomb along with the deceased. These small images were primarily to guarantee the performance of laborious agricultural duties for the Egyptian's life beyond.[3]

2 Von Ogden Vogt, *Art and Religion* (Boston: Beacon Press, 1948), pp. 9–10.

3 Alessandro Della Seta, *Religion and Art* (London: Adelphi Terrace, 1914), p. 97.

In order to understand and appreciate sculpture as a product one must know something of the referents for the symbol. For whatever reason sculpture may be created today, it is primarily the domain of the individual's integrity. Unfortunately the lack of interest in sculpture since the seventeenth century has helped terminate the development of our spatial intelligence, thus barring the present generation from an integration of sculpture and life. In spite of its economic means, our generation has not had the advantage of realizing the aesthetic visions of its sculptors.

The manifestation of sculptural experience has no boundaries except those imposed by the needs, skills, and imagination of the creator himself. To create a piece of sculpture one must be involved in a dynamic process in which all that exists between the creator and his universe becomes harmoniously integrated into a sense of well-being. The greatest value derived from the sculpturing process is a pleasurable emotional experience. Such a delightful experience is creative, and the manifestation may be called creative sculpture. On the other hand, when the doing is a means to superficial ends, the product takes on purpose beyond itself and can no longer be considered sculpture.

As a sculptor of integrity I find joy in reaching out to encounter the new and fascinating aspects of the world. My experiences, for example, with the brutality of cockfights in Mexico left me with curious compassion and a desire to experience further its significance. The urge to come to a better understanding and to enjoy the resulting intensification of such action compelled me to reinforce my experiences by integrating my seeing, thinking, feeling, and doing.

The essence of sculpture, as with all the creative arts, has always been the process of experience by which human ends are achieved. Its character, therefore, is not one of product alone but one of process. One certainty is that in every work of sculpture there can be traced the means of satisfying a human or cultural need.

Sculpture, like many other art activities, is still a process of exploring basic truths and discovering significant values. The shift of emphasis from appreciating it as a *product* to that of understanding it as a *process* may leave many readers confused and inarticulate, or it may lead to a clearer understanding and greater appreciation of creativeness in sculpture.

"Cock Fight," copyright 1953, Look Magazine.

A quick sketch of claw-action by the author in attempting to depict the idea created by experiencing a cock fight.

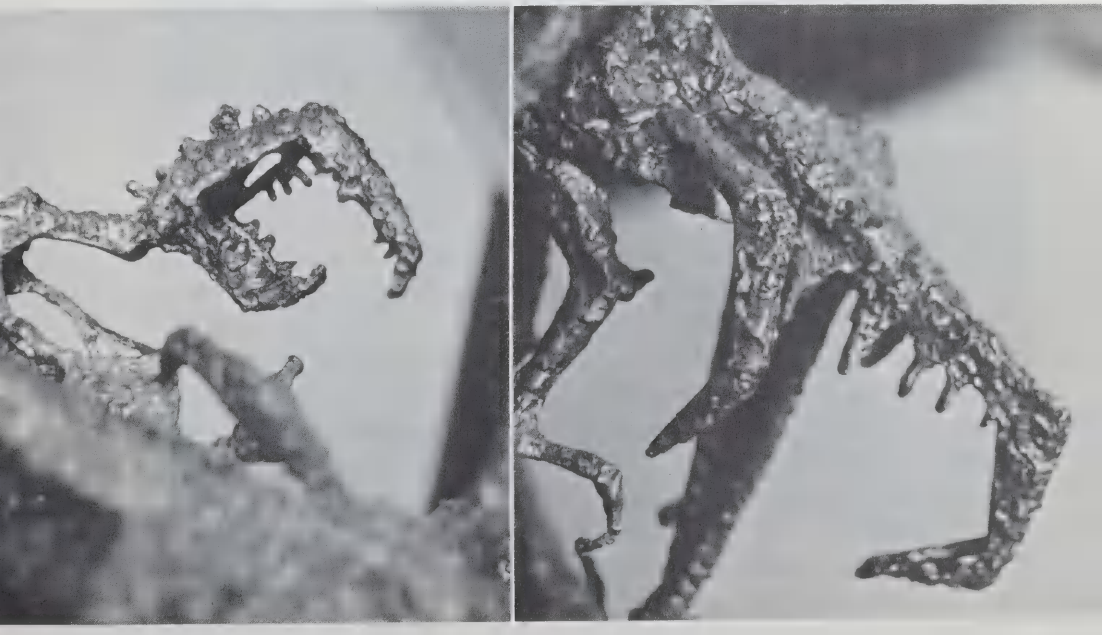
It was not until after many continuous attempts—first in clay, then wood, and finally in metal—that I found myself respecting and developing the integrating power within me from which I could feel alive, unique, and satisfied. The more dynamic the integration the greater the aesthetic quality of the expression.

"Cock Fight" is perhaps not as absolute and direct an execution as those of the more modern constructivists. However, it can be considered an aesthetic shorthand that gets to the point of expressing a dimension of nature with the greatest economy, ruthlessly eliminating all that is extraneous and irrelevant. The obscure literary association merely serves to identify the source of nature. The sensation of activity is conveyed by the disintegration of mass and the defining of space. I was able to depict a reality of great speed, struggle, and conflict by creating in welded steel—an effort to obtain a specific effect, in part, from the character of the material and technique. I explored reflected light and dark modulations, a variety of rough textures and angular forms.

The act of creating the welded image was an act of discovering my aesthetic sense: an extension of my being and becoming. It is not the result of an attempt to create a unique piece of sculpture nor to express

my own visual impression. It is, in reality, nothing more or less than a vital part of the continuous process of being integratively involved with a universal encounter with nature. The image itself is a visual abstraction of my discovery. The creative action was undertaken for its own sake and has its unique values. Neither the action nor the sculpture needs additional justification.

A single piece of sculpture such as "Cock Fight" is a composite of infinite aesthetic reflections both visual and meditative. As we observe the details of the cocks, the claw for example, we experience that which we as observers are and that which the artist's own immanent relationship with his world has become. We see and experience form, color, and texture; at the same time we feel the sharpness of the claws and the roughness of the medium, and subconsciously hear and taste and smell a variety of sensory recollections. Although the sculpture itself is stationary, it moves and changes its position as our eyes glance from one segment to another or as we move around it. The cocks are breathing slowly, now rapidly, screaming, and then suddenly all is silent. The observer is free to move on to a set of new experiences, to go his own way; but for the artist this communication of strong feelings, this reaction to impressions, the desire for self-actualization must



continue. Tomorrow he will take up his tools and start anew. My interaction with the universe is vehemently reflected in my works as well as in the works of others whom I appreciate and with whom I have intuitively chosen to align myself.

Sculpture is the privilege of the multitude of amateurs as well as of the artistically talented few. As I have attempted to illustrate in the following pages, sculpturing takes place at all age levels. After any serious consideration of the significance of sculpture, as well as other forms of art, we cannot help but be convinced that it is obligatory to have sculpture in our educational curriculum. It can no more be ignored with impunity than can painting, printmaking, the applied arts, and the more recognized academic subjects that are so readily available to today's students. To live insensitive to sculptural perceptions is to live a deprived life. Sculpture, like the other arts, may be created or contemplated for the values inherent in the process of asthetic inquiry, but for those who care to view it, sculpture also speaks a language that enlightens and cultivates. The more we apprehend through our visual experiences the more our human consciousness will expand.

Sculpture held a predominant place in the ancient cultures and throughout the first seventeen centuries after the birth of Christ. It was only after the seventeenth century that it became adulterated with elements that negated the fundamental principles of sculpture; it thus fell into some disrepute and was relegated to a subsidiary role. Fortunately, there is encouraging evidence that sculpture is again beginning to take on a more active role. It is fast becoming a vital force in the art education of all age levels.

"Cock Fight" (welded steel brazed with bronze) by the author (*private collection*).

Today's sculpture should be a vital creative force integratively associated with the general cultural revolution of our time. As in all ages there can be a direct analogy between art and the development in other spheres of the culture. In an age of atoms and missiles, the sculptural idioms of the past are no longer the prime quality of sculpture. The author cannot help but believe that the true legacy of great art is being ignored. We must be careful not to relegate our knowledge to an undeserved obscurity.

There are a few sculptors today who are more impersonal. They believe that there are universal principles implicit in the structure of our nature, and they seek to objectify them in visual realities. These sculptors are resolving their own answers to the enigmas of existence. They pursue an errant quest, and like the scientists, they are after the conquest of nature. Their interests are more intellectual and basic to asthetics and scientific truths. The expression of emotions and content is most often deliberately avoided. Today the sculptor is beginning to show a greater regard for materials, an interest in discovering the principles hidden in the structural complex of nature by penetrating her more profoundly than the art of the past has ever been able to do.

The value of sculpture resides not so much in portrayal—forms whose representational connotations are apparent and familiar—but in conceptions derived from structure. The creative sculptor today is an explorer and a scientist, not a storyteller.

In each new age, new and distinct tendencies evolve in sculpture. There are, in fact, many varied conceptions of our destiny. In the constructions by Naum Gabo, for instance, which so few of us can really understand, let alone appreciate, there is an attempt to define space.

He refutes bulk and mass by using a transparent material, emphasizing line and virtual space. His sculpture provides one of the transmutations that our new attitude toward life instinctively demands.

Much of today's sculpture records the discoveries of many great minds and visually reveals the principles of nature not too unlike Newton's law of gravity, Einstein's theory of relativity, Maxwell's electromagnetic wave theory, or Copernicus' scientific theory of the world. The great variety of human insights has a great deal to do with the kind of sculpture produced under its influence.

In the creations of today's sculptors, for example, there is a pronounced reaction from the sensual-sentimental individualist's approach toward a more objective outlook. Today's sculptors proclaim the sovereign virtue of space. In their investigations of space they reject mass as an element of plasticity and sublimate it into virtual volumes by using light, transparencies, and line. These are the prime qualities of our age. As long as man is the determining factor, sculpture should reflect the age in which he lives. The modern sculptor enables movement and space to become the fourth dimension of sculpture. It is not a form of self-indulgence, disdainfully remote from our daily lives, but an optical reference similar to the transformations in psychology, physics, technology, and aesthetics. Modern sculpture reflects a new reality as unique as today's scientific discoveries and just as full of promise.

In our age, which is pre-eminently an age of science, the minds of artists are focused sharply upon search and discovery for the sake of greater integration and development. The greatest contribution that sculpture can make to one's understanding and appreciation is to be exemplary of the truths about the processes of the life of the times.

PART
ONE

Modeling

Most of us, especially children, are intensely interested in plastic expression. Modeling is therefore a natural activity for all of us. To manipulate, model, or fashion with such pliable and yielding materials as clay, wax, plasticine, papier-mâché emulsions, and even homemade mixtures of dough and sawdust clays is an interesting and delightful experience. Modeling is, undoubtedly, one of the greatest arts, and as an educative device has as wide a scope as any other branch of the visual arts. Modeling materials give free play to physical dexterity and the

imagination and are, therefore, appropriate even for the youngest of children. All such materials are essentially the same in character although each may have its advantages and disadvantages. They all respond to the basic principle of modeling. The medium to be selected is up to the individual or the teacher, in the case of children, and dependent upon the availability of materials. Almost anyone can squeeze, push, pull, twist, and press the material with his hands and fingers into a great variety of shapes. Modeling materials permit the fashioning of an array of objects with a wide range of treatments, from the simple egg, ball, snake, and hot dog or cigar to the highly complex, open, abstract forms.

Characteristics of clay

Potter's clay is the most commonly used and perhaps the least expensive of the plastic media. It may be found in any part of the country if one cares to dig for it and process it himself, but it is much simpler to buy clay already prepared. It may be purchased from almost any art supply firm in either the dry powder or the wet form ready for use. Wet clay, which is prepared and sold at the right modeling consistency, is slightly more expensive than dry clay, but the cost is so nominal that the purchase of dry powder clay is no longer an advantage. Wet or *pugged* clay usually comes in twenty-five pound lots stored in a plastic bag, which will keep its original consistency from nine to twelve months without additional care.

Potter's clay that is sold by commercial firms is usually a mixture of several clays and added ingredients such as bentonite, grog, feldspar, flint, and cryolite. These clay mixtures are usually referred to as clay bodies. They are prepared with special working characteristics and firing properties. Some are prepared to fire at relatively low temperatures in inexpensive kilns,[1] which is of particular concern to elementary and high school art teachers. Potter's clay is a yielding plastic medium capable of being fired into a vitrified form. There are also a few self-hardening clays that have made their appearance on the supply list. They are advertised as clays that harden in an ordinary kitchen oven at approximately 300 degrees Fahrenheit. These self-

[1] Most kilns found in the elementary and high schools are designed to work off a 110-volt line and fire at cone 06 (1840 degrees Fahrenheit). These kilns do not require special electrical wiring as do the more expensive high-firing ones.

hardening clays may be used by schools that do not have a ceramic kiln, but the teacher should always realize that they will not take a truly vitrified form in the same way that potter's clay does.

The care of potter's clay

The proper care of modeling clay is of the utmost importance. Children who are required to use clay that is too short (not plastic enough) or too long (very plastic) soon become frustrated, discouraged, and all but lose their desire to work with it. The proper consistency of clay is therefore our first concern. Its importance as a factor in successful modeling cannot be overemphasized. The right consistency gives children a suitable frame of mind, satisfaction, and a workable medium. We may assume that at the beginning our clay is at the "just right" consistency. If it was received in a plastic bag, we need do nothing but store it in a convenient place free from radiators, fans, and air vents. Once the plastic bag is unsealed, precautions must be taken to make sure that it is tied securely when not in use. The children should be informed not to let the bag remain open after getting their clay. Instructing the children in the proper care for the clay will prove not only educative and habit-forming for them but also a great help to the teacher. Placing the plastic bag in a stoneware crock is similar to placing it in a damp box, a procedure that makes handling of clay much easier. Twenty-five gallon stoneware jars with lids, which may be purchased at any hardware store or nearby pottery plant for as little as a few dollars each, serve well as damp boxes. They are useful not only as receptacles for the workable clay but also for storing hardened clay that needs reclaiming.

Processing short clay

Short, or leather-dry, clay can be reconditioned by punching holes into its mass with a stick or pencil, pouring water into the holes, and wrapping it with a wet cloth. The wet clay and cloth are then covered with a plastic or rubberized sheet for a few days. If the clay becomes too plastic, it must be exposed to the air, and later kneaded and wedged into a consistent texture. Bone-dry clay, however, must be submerged in a crock of water; after the clay has dissolved, the clear water is drained off and the clay is left standing and later laid out on a plaster bat to dry and become plastic. Large pieces of dry clay should be broken up in order to hasten the reclaiming process. Overworked clay loses its plasticity and periodically needs reconditioning.

Processing long clay

Any clay with an excess of water can be dried by putting the clay on a plaster of Paris bat. Plaster bats may be made by filling pie tins or cake pans with a mixture of plaster of Paris and water, which is then allowed to set.[2] The bats may be removed from the pans and placed over a radiator or a register to dry. The drying process can be hastened by placing the bats in an oven at a heat of 120 degrees Fahrenheit. If the heat exceeds 120 degrees Fahrenheit, however, calcination may result and the plaster bat will disintegrate. Plaster bats absorb the moisture from the wet clay, leaving it flexible and responsive. But plaster bats have a tendency to become damp, especially if used too frequently or if exposed to a damp atmosphere. If this happens, it is advisable to dry them as often as necessary. Care must be taken not to leave wet clay too long on the plaster bat, or the clay will become too dry. If this occurs, it can be sprinkled with water or rolled in a damp cloth and left for a while.

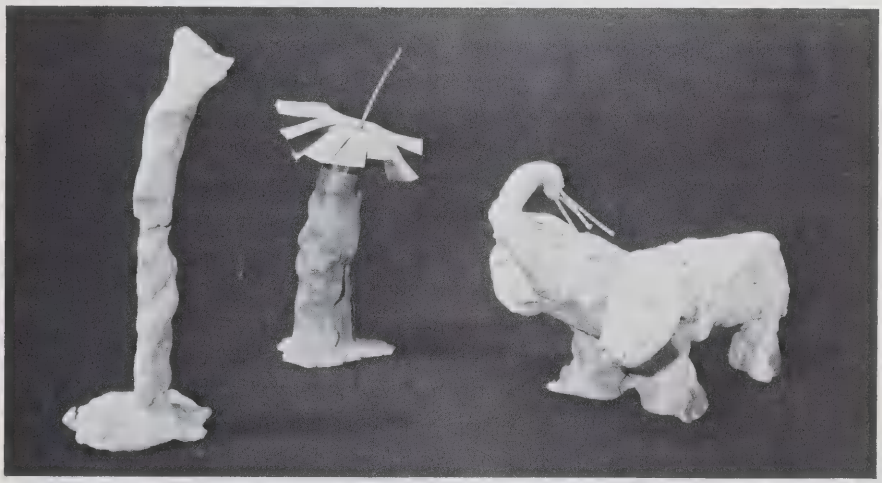
Tools and equipment

Potter's clay is a substance that has perhaps been used longer than any other medium. If one may trust the conjectures of anthropologists, one is assured that man modeled in clay long before he drew on two-dimensional surfaces or carved in wood or stone. The ease with which clay can be used makes it a natural material for promoting an experimental attitude. It affords children a perfect means of self-expression. One great advantage of using clay is that it requires no intermediates such as tools that can constitute barriers to the child's ability. Using only his hands and fingers, he is free to concentrate on his intended expression. Older children, however, may be encouraged to use a variety of tools, which can be most helpful in expressing their more complex ideas. Orange sticks, tongue depressers, toothpicks, wire loop ends, blocks of wood, pieces of a hacksaw blade, a spoon, a butter knife, and a fork are but a few of the household items

2 The plaster of Paris–water ratio determines the hardness of the plaster. To make plaster bats, sift plaster of Paris into a bowl of water until the plaster powder rests on the water and begins to look like cottage cheese. This is the point of saturation that will give the necessary results. Mix thoroughly and allow to set for at least 30 minutes.

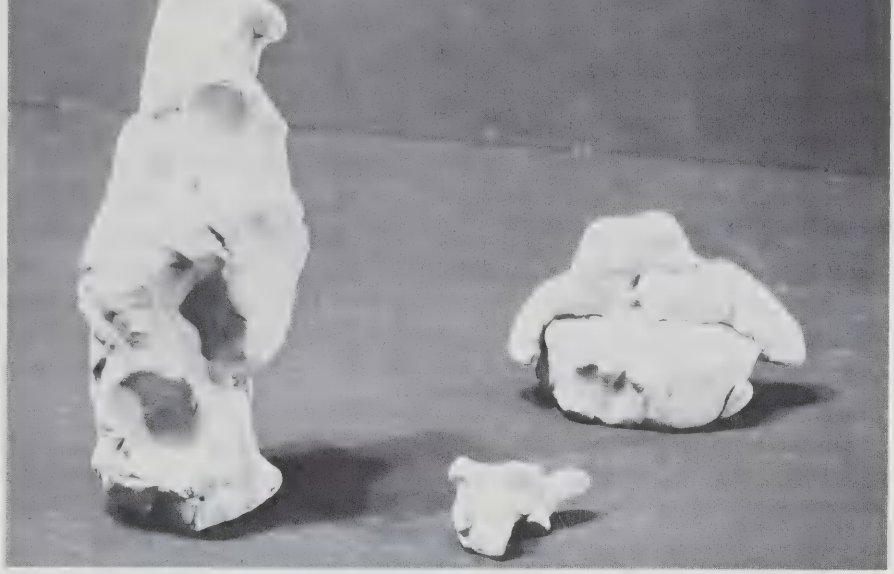
that can be employed by the student in clay modeling. Some students, in fact, are capable of making their own tools out of soft wood, wire, and tin cans.

In addition to these simple tools, various pieces of equipment are essential in the support of the creative process in clay modeling and pottery. Among these are a clay storage cart or bin, a wedging board, a banding and kick wheel, a spray gun, a frog, a damp box, modeling boards, plaster bats, and mixing bowls. Others pieces of equipment that are not as essential but convenient to have are an electric modeling wheel, a gram scale, a pair of calipers, a face mask, dipping prongs, a ball mill, a modeling stand, and an electric drying cabinet.



Armatures are necessary for modeling large images, especially if one is to be given freedom from complexities while expressing his thoughts and giving his interpretations. Armatures are used to support the pliable clay until it hardens enough to support its own weight. They may vary from a single cubit of clay to a very complex structure supported by wire mesh, back irons, wooden wedges, butterflies, mortise tenons, or metal braces. The supports for elementary school use, of course, never require anything more complex than a single dowel rod, block of wood, or clay prop. When delicate pieces are being modeled, a piece of clay or wooden block will serve nicely as a temporary support.

When the clay is firm enough the support may be removed. In the case of elongated projects in which a dowel has been used, it is imperative to remove it before the clay becomes leather-hard; otherwise, later one may find it difficult or impossible to remove. A paper core construction is a very good support for modeling an attenuated piece, especially if the piece is to be fired. The paper can easily be fashioned in contours similar to the proposed shape of the piece to be modeled. Should it be difficult to remove the paper core later, it may be left to burn out in the firing. For more compact and solid pieces, such as heads, an inverted bag of sand is often used. After the clay object becomes leather-hard, the sand is released and the bag easily removed.



Procedure

The first problems that usually confront the teacher in clay modeling are how to begin, what to teach, and how to assist the children to self-discovery that will lead them to produce good sculpture. To begin, the children should be furnished with sufficient clay to experiment and explore. Usually a piece the size of a softball is adequate. It is imperative, however, that the clay be quite malleable and adaptable, especially for the very young children. They should be encouraged to use their hands and fingers to squeeze, push, pat, roll, and twist it. The moment children begin to redesign the shapeless mass they begin to sense weight, plasticity, volume, and the free flow of mass forms. The wise teacher will encourage children in divergent thinking: to try poking holes in it; to make it grow tall and thin, long and wiggly; to pound it flat and squatty; to pile it high, one piece on top of another; to weave its strips and coils; to scratch it, to comb it, to mark it with a pencil or stick; and to make it into all kinds of regular and irregular shapes. As they become more familiar with the medium, they may be encouraged to combine with it other materials such as colored sticks, beads, nails, pipe cleaners, sawdust, marbles, toothpicks, and bottle caps. As they begin to symbolize they are inspired to turn their forms into recognizable birds, bugs, baskets, and a host of animate and inanimate objects in keeping with their interests.

The more they are permitted to experiment with and explore the clay, the more they will understand the possibilities of its use and find the meaning of their own efforts. Nondirective practice in handling clay is what children need most at this formative stage. Repeated opportunities to explore and experiment are the best ways they have to develop. Children should not be rushed. Teachers should allow plenty of time with each new idea and should not become impatient if their progress is seemingly slow. As children work, their fingers grow more deft and effective, their thoughts and ideas more astute, and their manifestations more explicit.

There is no set procedure for modeling clay. Modeling methods are individual. One child may proceed by a building-up process; he may put pieces of clay together into a whole. Another may start with a mass of clay and pull into being various parts from it. Invariably, one may find a child who wants to shape the whole object from one mass of clay by pressing, pulling, and forming the parts and adding only such dominant appendages as legs and arms. Whatever method the child employs should be encouraged providing it appears to be his natural way of working. When he asks, "May I make a little bunny?" the teacher should respond with "Why, yes, Jimmy, if you have an idea, we certainly do want you to make it in clay." With this encouragement Jimmy will be off to learn to speak a new language. If only all the other children would show such initiative. We no longer attempt to confine every child to a predetermined subject or method as was done in the past. Today, creative independence is highly valued and should be encouraged.

Since children are not all alike, the teacher's guidance will have to vary in accordance with the needs of each individual child. Some may be left to find their own way with as little interference as possible, whereas others, the inhibited, will have to be supervised and guided more closely. In creative arts, however, the teaching of individuals according to their own bent is the most desirable.

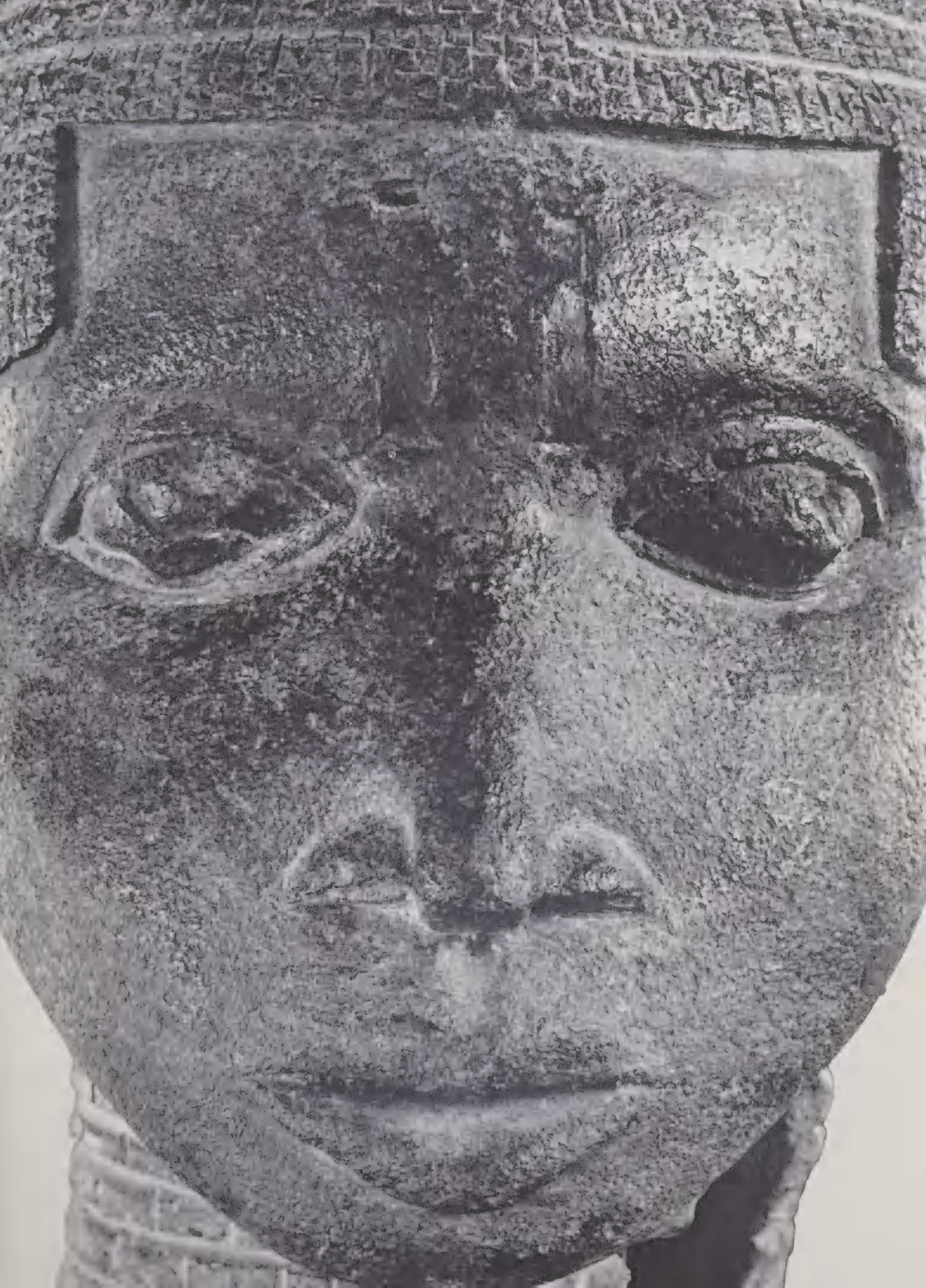
Children who have previously had experiences with clay will also profit from the experimental approach. They are now capable of bringing more dexterous skills and evolutionary ideas to bear. Because of physical and mental development, slightly more mature children are capable of handling clay with more facility and exhibiting a greater variety of forms and treatments. They reflect a greater respect for the material, are more sensitive to its character and more competent

to bend it to their will. There is nothing more natural than for children to model from the current experiences that are in their minds. They should be inspired to derive their images from their most extensive and intensive life experiences: pets, inanimate objects in their immediate surroundings, members of their family, and close friends. Subject matter that is not a part of their lives is divested of all educative value, no matter how well it may be learned for its own sake.

At the beginning, a child will usually attempt to model objectively. His is an inventory of things: a dog, a bird, a car, a gun, a doll, or a man. He does not see things specifically as a particular kind of dog, or subjectively, with personal interpretations. Such unemotional and unexpressive works are to be commended as truly educative, although they do not necessarily fall into the category of art. The more emotional quality of their expressions is usually found in the verbal interpretations that accompany the visual forms. Children should, therefore, be encouraged to talk out their thoughts and feelings. Verbal expression is as beneficial to one's aesthetic development as are more visual expressions. The expressive quality becomes noticeable in visual form as children grow in their ability to control art materials for the precise purpose of self-expression. They will soon discover that modeling is mainly a process of transferring ideas into tangible plastic media. They no longer model animals and people per se, but are more interested in having them doing things. The horse becomes a prancing horse, the dog a vicious dog, and the boy is now a baseball player.

"Motherhood" (clay) by an eleven-year-old, Higher Institute of Art Education for Men Teachers, Cairo, Egypt. *Courtesy of Dr. Mahmoud Y. El-Bassiouny.*

"Head" (clay), Nigeria, Benin Tribe. Photographed by Warren Schuman. *Courtesy of Mr. and Mrs. Allen Alperton, New York.*



"Hen and Chicks" (clay) by a fifteen-year-old, Orman Modern Secondary School, Cairo, Egypt. *Courtesy of Mahmoud Elnabawy Elshal.*

Children are naturally aesthetic minded, but most of them may be so inhibited through neglect, lack of opportunity, or, perhaps, adverse teaching that they may not respond to this creative approach even in the presence of good teacher-stimulation and motivation. The wise teacher will seek to understand the needs of these children and attempt to release the dormant force within. He will inspire them to use their imagination and to find their own way of working with a variety of materials. Certainly, the teacher is to give them the benefit of his own experience, but it must be remembered that the child's inalienable right is to experiment, explore, and discover his own thoughts and ideas. Every child is endowed with an inherent way of interpreting his environment and selecting art forms that to him have meaning. Generally a mere suggestion is all that is needed to call forth the most original conception, and once started, the child will soon far outstrip this suggestion.

The more mature individual should be encouraged to think out his ideas before beginning to model. He should be encouraged to have something to express and he should be permitted to analyze, choose, design, reject, and redesign in seeking the most effective way. The thinking out of one's ideas helps to give order to experience and results in a more satisfactory art form. If a model is to be used, children are taught to observe, not so much in order to render the object faithfully, but to be stimulated by it. Should they desire to do a naturalistic study of the human form, it is a good thing to help them to understand the structural principles of the human body. The same may be said for the study of animal anatomy and plant forms.

Many art educators recommend the avoidance of complicated, delicate, and complex subject matter. They suggest that children be motivated to confine ideas to simple, massive, compact objects, to formulate ideas that do not require structural supports or reinforcements. Compactness may hold true for the carving processes, but it is doubtful whether such advice is sound when applied to modeling. If children are to learn the importance of integrative expression of thoughts and feelings, which invariably are complicated, it would seem more appropriate that they adopt form and treatment to ideas rather than let the predetermined nature of the material dictate the desired ends. Many sculptors model in a simple and compact style. This is of course unfortunate, for had they been encouraged to challenge law and tradition, they might have discovered new and exciting forms and innovated sculpture comparable to Frank Lloyd Wright's advancements in architecture, which defy the more provincial, Classic, Gothic, and Modern structures.

"Fable of The Industrious Farmer" (reduced stoneware clay with vitreous slip) by William Parry, Alfred University. *Courtesy of the artist.*

"Yearlings" (terra cotta) by Bernard Frazier, University of Kansas *(Collection Joslyn Art Museum, Omaha, Nebraska)*.

"Moses" (modeled in potter's clay and cast in plaster of Paris) by the author (*private collection*).

The advocacy of simple, compact, and solid forms are no longer characteristic of sculpture today. In its place the use of protruding parts, delicate and intricate abstractions and subjects such as bicycles, airplanes, and trees are not only acceptable but encouraged. Ceramic sculptured mobiles, vibratiles, and stabiles can be seen on exhibition throughout the United States and abroad. Children should be encouraged to express their complex ideas. Although the teacher should not attempt to teach modeling by the direct method, he can be an indispensable aid in the learning process. He can help each child with his structural problems and encourage the use of string and wire so that the child can record his fleeting impressions in open and free designs.

During the adolescent and more mature years the teacher may give more attention to effective individual expression. He should explain how color, texture, and form can help one express and formulate one's ideas more intelligently. He does not direct, but points out how form is organized and simplified to denote character. He emphasizes that art may appear simple, complicated, or tranquil; or it may appear complex, expressing turmoil, excitement, and dynamic action. The teacher can help to point out the desirability of subordinating irrelevant details.

"Sconce" (earthenware made of dry clay and slip and colored earth green to brown with copper, manganese oxide, nickel, and iron) by Gloria E. Crouse, Olympia, Washington. *Courtesy of the artist.*

Students must be taught to go beyond what they see to interpret past experiences and feelings; but impressions are possible only when form, color, and texture are arranged into a symbiotic composition. Students must be made to realize that there is a special kind of distortion in which natural forms are changed for a purpose, and that forms are so arranged as to lead the observer's eye from one to the other in meaningful order and in such a way as to express thoughts and feelings.

By all means, the student must seek to find and use ideas of his own, but the creative teacher can help greatly through demonstrations, discussions, and group participation. He can help the student understand the significance of his original efforts and their relationship to his art.

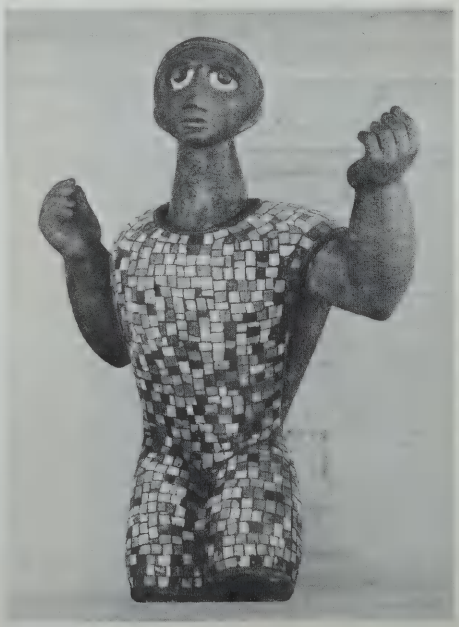
The teacher will remember that many students do not know the meaning of such words as form, volume, rhythm, and contrast, and that he should teach the meaning of such words. The method of teaching is irrelevant as long as the words are taught meaningfully. In addition, the teacher should help them to discover texture, plasticity, and movement and to understand the three-dimensional quality of clay. Inexperienced students' modeling usually has a tendency to be two-dimensional since the greater part of their art experiences have been limited to two-dimensional projects.

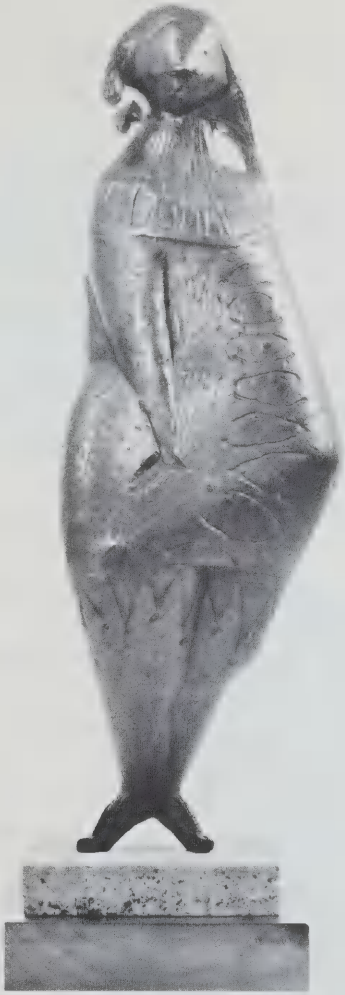
"Two Women" (clay) by a thirteen-year-old, Fustat Secondary School, Cairo, Egypt. *Courtesy Mahmoud Elnabawy Elshal.*

The teacher can also encourage students to work on both large- and small-scale projects; to open up a new world of surface treatments through the use of clay pellets or cuboids, toothed tools and scrapers, and color; and to use with the clay a combination of materials such as paper, feathers, wood, and wire. The combination of materials is not a new idea. Perhaps the richest combination of materials is that used by the Greeks in the fifth century B.C. to ornament the cult images with inlays of precious stones, ivory, silver, and gold.

The teacher is constantly helping the more mature students to acquire more effective habits of working with clay and of establishing their own standards of achievement. He points out the consequences of their efforts and helps them to gain more mature judgment and insight and to be self-critical. The adolescent is told to step back from his work occasionally and to take a look at the clay object from all sides and from the top. As he models he is encouraged to concentrate on all areas of the form and to hold detailed modeling in reserve until the desired basic form is obtained. The desired procedure is to work over the entire piece constantly and continuously until the parts are completed almost simultaneously.

Left, "Figure" (clay) by a college student, University of Wisconsin. Right, "Joseph and His Coat of Many Colors" (inlaid tesserae in stoneware) by William M. McVey, Cleveland, Ohio. *Courtesy of the artist.*





"Harlequin III" (clay cast in bronze) by Dominick Angelo, Syracuse University. *Courtesy of the artist.*

If the teacher is to be of help, it is imperative that he himself know a great deal about the art of modeling. He should understand the structural principles, the characteristic properties, and the limitations of clay, some of its commercial values, the techniques of preparing and using glaze, and methods of firing the kiln. The wise person, however, bears in mind that the essence of good teaching is to keep this knowledge in reserve. He can make two major contributions: first, to help the children sense the dimensional characteristics of a variety of modeling media; and second, to help the student recognize that modeling is a means of personal expression.

Modeling as Self-Actualization

In creating sculpture, as we so often have come to know it, there can be many tantalizing paths that easily lead through technical labyrinths to dead ends. Since we are not primarily concerned with sculpture as an end product, we shall speak of it only as a process of developing the human potentialities inherent in man and not as a branch of manual training. It is here advocated as a means of teaching the art of thinking and feeling intrinsically, in other words, of actualizing the *self*. Emotional concepts, the power of interpretative thinking, and instinctive feeling are held more important than technical achievements. Modeling, as well as any other art worthy of being considered an educative process, can no longer afford to ignore the personal equation.

Creative modeling is not a faithful following of predetermined procedures. Imposed methods of construction, taught with the notion that they are ends in themselves, have all but eliminated the educational value in art instruction. Those who assume that the individual can go from technical instructions to the application of any number of design variations in an imaginative manner are teaching under a misapprehension. Technical knowledge and manual dexterity without perception and insight will not result in creativeness. Teaching whereby children learn to make type-forms is to be carefully evaluated. It might have been of some significance to the past, but it is not congenial to the aims of art education today. Such a method usually produces stereotyped results and deprives the individual of the opportunity of conceiving his own ideas and seeing and solving his own problems. It does not permit him to draw upon his experiences and imagination, which are much more fruitful and responsive than any teacher-devised exercise. Sculpture as such is not considered art any more than grammar is considered to be literature. Demonstrations of predetermined stock-methods are dead beyond their illustrative purpose. If the individual is not free and not encouraged to go beyond that which he has just witnessed, if he is not motivated to improvise, to experiment, to analyze, to criticize, and to select, all, or almost all, is lost. We must escape the old concept of modeling as a fixed discipline—a body of facts and technical rules to be imparted in a uniform way—and create a free, natural atmosphere in which the individual can respond aesthetically.

The static procedures of previous generations are slowly giving way to more dynamic methods of teaching. Stock-methods are not recommended since they only deprive the individual of the vigor of his thoughts and actions. All that the teacher needs to do is to point out the sculptural principles, provide the favorable conditions for the manifestation of the creative spirit, and leave the individual to create with a minimum of interference. Aesthetic response can result only if the individual is free to attempt many different things with clay and to observe the results. The diversity of output by a creative class will impress upon the student the difference in human ability and the significance of being creative.

"Small Horseman," 1949 (cast in bronze), by Marino Marini. Photographed by A. J. Wyatt, Staff photographer. *Courtesy of the Philadelphia Museum of Art (Louis E. Stern Collection).*

Experimental Modeling

If the learner is a very young child, let him feel the nature of clay, its rhythmic and tactile qualities. Talk to him of his ideas. The demonstration of a technique or distinct process is acceptable provided it is a means to a noble end; but if it is exploited for its own sake, it becomes trivial and noncreative. Children are encouraged to seek to do that which, to their knowledge, has never been tried. This is done in order to have them seek for themselves that which works best. Stimulate them to manipulate clay with little concern for prescribed techniques and end products. Have them press, model, hollow, and hew the clay into sculptural forms—into spherical and cylindrical shapes. The older students may be encouraged to try a variation of complexities such as spheroids and cylindroids with surface depressions or deep hollows. These and other free forms represent a departure from conventional type-forms. Encourage original surface treatment by experimenting with applied clay, scrapers, and insertion of paper pellets or sawdust, which burns out in firing. The student should use clay in such a way that the outcome will be his own. This is the true language of creative sculpture. He may at first be lost, bewildered, and frustrated, but soon he will become cognizant of the creative habit. Revelations will soon

Left, "Figure XI" (clay) by George Manupelli, Central Michigan College. Professor Manupelli, a painter, attempts flexibility in a sculptural medium. Right, "Untitled No. 1" (clay) by Donald Tompkins, Syracuse University. An experiment with the characteristic of potter's clay.

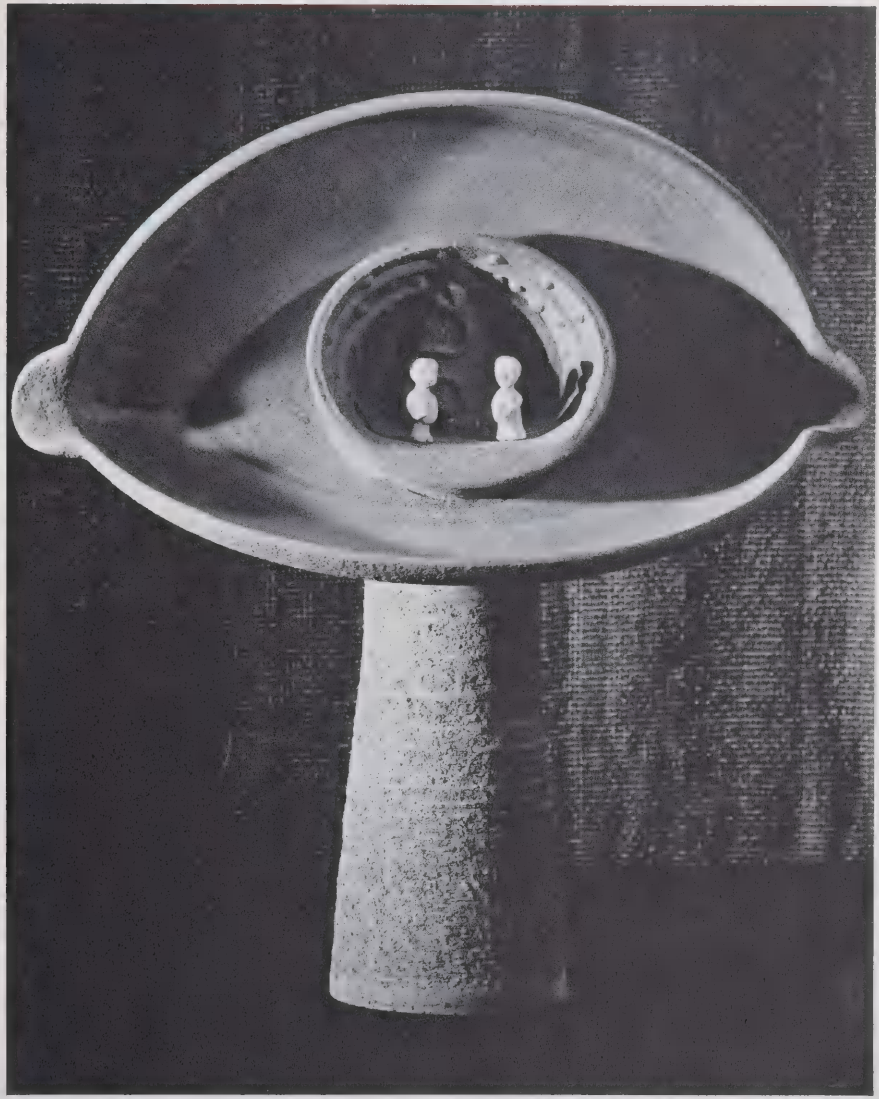
begin to come to him and he will begin to feel his own way. The more he experiments, the more he will come to understand the possibilities of his own efforts in clay. The creative student will arrive at his own way of working, his own concepts of form, and his own feelings about texture, mass, and volume, as well as applied design. As he seeks to express himself he will continually create with greater discrimination and vision.

The wise teacher considers the age level of the learner he is teaching and gauges his methods of stimulation accordingly. Older students may need to be stimulated to a greater range of possibilities. It is for this reason that a teacher should have a thorough knowledge of principles and medium. This, however, does not mean that he must establish a graded series of projects to be administered at certain levels and evaluated according to a yardstick of standardized expectancies. It is ridiculous to say that certain methods in sculpture should be reserved for particular age levels. Everyone can fashion clay, design it, and give it color and texture. There are aesthetic and technical exercises that are beyond one's ability, to be sure, but in most cases these are problems lying outside the range of one's comprehension or physical ability. They are not self- but rather teacher-imposed difficulties.

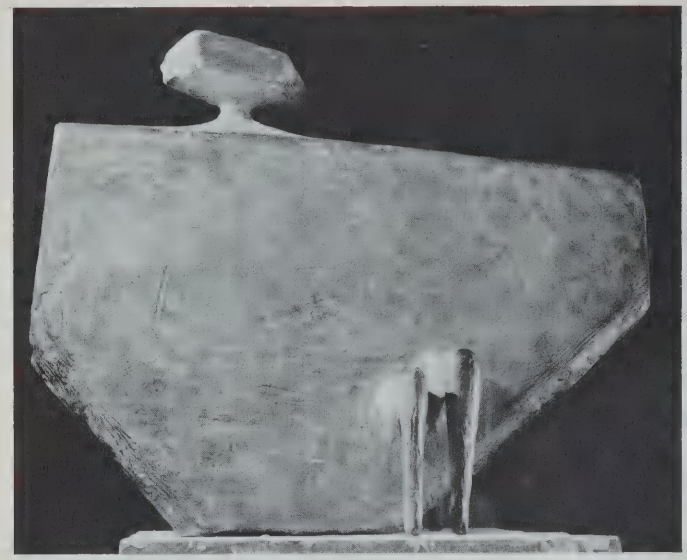
Throwing sculpture on the potter's wheel

Throwing may be referred to as the process of forming clayware on the potter's wheel. It may be classified as a technical aspect of the principle of pottery making, to be sure, but it does not limit the individual who has ingenuity and has been stimulated to think freely and to exercise his aesthetic powers. Throwing allows the imaginative individual to produce rhythmic and beautiful shapes with the freshness of a watercolor. It is synonymous with such structural principles as modeling and constructing. The more creative individuals will more likely use it as a point of departure, attempting to express their feelings for creative expression in an array of variable shapes. If properly motivated almost anyone will try to throw sculptural forms from the basic cylindrical shapes. His creative imagination will encourage him to pull, press, and pound the cylindrical forms into all kinds of animate and inanimate shapes, trying to discover more interesting and functional sculpture.

"Artist Figures" (thrown sculptured pottery) by Edwin Scheier, University of New Hampshire. *Courtesy of the artist.* "Saint" (thrown sculpture padded, impressed, and painted with black and white slip) by Fred Lucero, San Jose, California. *Courtesy of the artist.*



"Adam and Eve" (thrown sculpture) by Edwin Scheier, University of New Hampshire. *Courtesy of the artist.*



"Slab Figure," 1961 (cast in bronze), by Kenneth Armitage. Photographed by Harriet Crowder. *Courtesy of Marlborough Fine Arts Limited, London, England.*

Relief modeling

Clay modeling may be done in-the-round or in relief. Thus far, we have been describing the process relative to images that are free-standing or in-the-round. These are the clay objects with which we are most familiar, those designed to walk around, to view, and to appreciate from any point on a 360-degree radius. Although modeling in-the-round should be the most natural for children since it is the nearest and most imitative approach to life—in essence, three-dimensional—we find most children more capable of modeling in relief. They have been conditioned to work on a flat, two-dimensional surface by their considerable experience in drawing and painting. As a result, we find it advisable to begin with one of the simplest forms of relief such as *intaglio* or *cameo*. *Intaglio* is a form of relief modeling in which the child starts with a solid slab of clay, approximately one inch in thickness, and engraves or imprints his design below the surface of the clay face. *Cameo* is a more positive form of relief modeling in which the image or design is imprinted on or above the surface of the clay.

Since it is natural for the child to build upon a flat surface, he can be encouraged to incise parts and build up others of his clay surface

until he achieves a combination intaglio-cameo relief. This is much the same as modeling in-the-round only the finished product appears flat and less three-dimensional.

The two methods of relief modeling most frequently found among young children are the incised and the *mezzo,* or middle relief. *Mezzo-relievo* is easier for young children to model than either the low or high relief. It does not call for subtle manipulation of vistas or elevations as does the low relief. The low relief and high relief are challenging even to the experienced modeler. A sixth-grade student may even attempt a coelanaglyphic relief. As in this Egyptian type, modeling of the image can be done below the surface of the clay while the unidentified, raised background is allowed to remain untouched.

"Stela-Maat," Nable from Kurna, Antef Cemetery (limestone), Egyptian XII Dynasty. *Courtesy of the Metropolitan Museum of Art (Roger Funds, 1914).*

Care of In-process Clay Projects

It is very important to keep potter's clay moist while modeling, but at the same time it is important not to allow it to get too moist. Clay pieces in progress should be covered with a damp cloth when being stored. Flannel is a good absorbent cloth to use. Wet the cloth and wring it out thoroughly before wrapping the project. Each day the clay will, of course, dry and harden a little as the modeler works. The rapidity of drying is relative to the atmospheric conditions of the room, the consistency of the clay, and the size of the project.

As the children model in clay, the teacher should have them occasionally wet it with a sponge, an atomizer, or a spray gun to preserve its malleability. Clay should not be worked immediately after being sprayed, but shortly thereafter. If for some reason the pieces cannot be completed for several months, it is advisable to replace the original damp cloth from time to time with others to prevent mold from forming. Pieces that are too intricate to cover or that have advanced to a point of delicate texture may be placed in a damp box or crock without a damp cloth. If neither of these containers is available, it may be feasible to insert swab sticks, reeds, or wires temporarily into the sculpture to keep the damp cloth away from the clay, thus preventing the blurring of any detailed modeling. If the clay pieces are modeled on a shellacked piece of masonite or plywood, handling will be facilitated, the desk will be protected, and school housekeeping will be less of a task.

It is inevitable that since children attach lightly and insecurely such parts as arms, legs, head, nose, eyebrows, and hair, these appendages will be quick to fall off. The wise teacher will wait for her cue and then suggest methods for more secure attachment. She may discuss and demonstrate how clay parts may be jointed by forcing a clay-weld, that is, merely pushing the clay pieces together as though to mold them into one piece. If parts of the project have to be added after the clay is leather-hard many shallow grooves must be scored with a potter's knife or sharp instrument in the ends of both pieces. Slip, a more plastic or putty-like clay about the consistency of toothpaste which acts as a mortar, is placed between the two pieces, which are then pressed together gently until the excess slip squeezes out. The excess clay is

removed and a short clay inserted to prevent the joint from showing when the moisture evaporates from the more plastic clay. Bone-dry pieces cannot be joined together. Such technical advice is given to the child only when he indicates a desire to have the pieces hold together or when he appears to be disturbed because they fell apart.

Preparing the Piece for Firing

The walls of the ceramic sculpture usually should not exceed two inches in thickness. To prepare for firing, the child must hollow the piece out to prevent its breaking. He may dig out the excess clay from the bottom with a spoon, wire loop, or fork, leaving the sides from one-fourth to two inches thick. More complex pieces that do not have a wide bottom from which clay can be removed may be cut into two or more pieces with a sharp knife, hollowed out, and then stuck together again by the clay-weld process. The hollowing out of the clay must be done when it is leather-hard to prevent disfiguration or collapsing of the sides. Care must be taken that air vents or holes are left to allow the hollow space to breathe during the firing process, thereby preventing accumulated steam from blowing the piece apart.

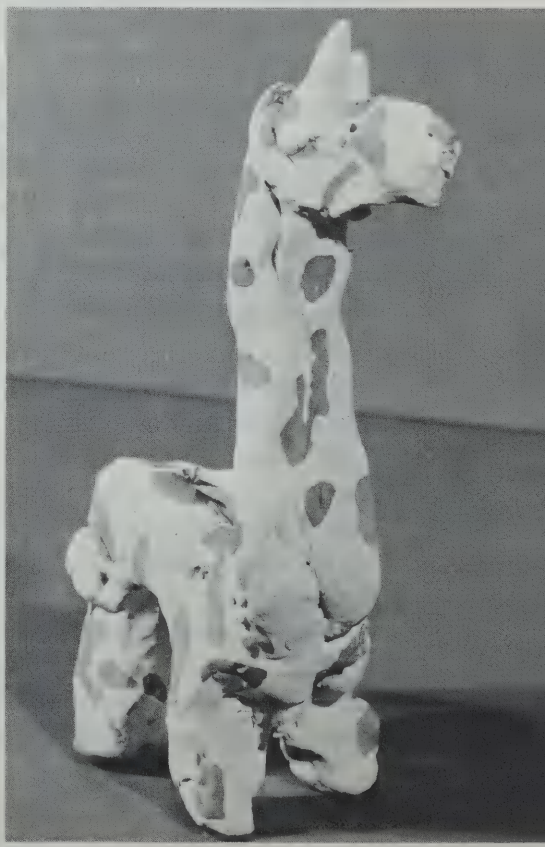
Since the very young children might not be capable of hollowing out their pieces, it is recommended that they use sand or grog to make the clay more porous and to allow them to exceed the two-inch limit. Grog is calcined, pulverized, fired earth clay, the inclusion of which reduces the shrinkage, warping, and breakage caused by firing. Grog clay bodies may be purchased already mixed, or grog may be made by crushing pieces of bisque (fired but unglazed) pottery.

Another procedure for the young child who wants to create a large piece may be to model around a wet paper core. The contours of the paper core construction should be similar to the clay form to be fashioned. The paper is covered with an inch or two of clay and then modeled. The paper can be easily removed when the piece is finished. If it should be hard to remove, as explained before, it may be left to burn out in the firing process.

When the clay model is finished and ready to be fired, it must be carefully dried by alternately keeping it covered and exposing it to the air. Drying the clay sculpture is a slow process. Too rapid drying may warp or crack the piece.

Methods of Decorating Clay Surfaces

Having finished creating the sculptural pottery, the student can now turn to a process that provides many challenges for his imagination. Decorating the surface of clayware can and should be as creative as any expressive art. Young artists are usually not content to leave their clay pieces uncolored or undecorated; they find great satisfaction in embellishing them. Surface decoration, however, must be applied with purpose relative to the functional aspects of the piece. It must enhance the expressed desire that the student intended to incorporate into the structural design. Often the artist needs nothing more than a glaze to complete his feelings. If this is the case, he should recognize the fact that any applied design might only serve to destroy the intended effect. We shall describe below some of the simpler methods of decoration suitable for the young student as well as the more mature amateur artist.



"Giraffe" (underglazed, unfired) by an elementary school child.

"Mastodon" (terra cotta decorated with gold leaf and oil paint) by the author *(James A. Schinneller Collection).*

Coloring earth clays

Whether clay images should or should not be colored with paints has long been a principal concern for the art teacher. He, unfortunately, has been confronted with the prejudices of the professional ceramists who think of modeling in connection with the complete process from its inception to the glazing of the sculpture. Ceramists have for years influenced the thinking of our educational program, but they have given little thought to educational benefits. Today, however, such usurpation by the ceramist has been challenged, and the teacher no longer bows to his professional predilections. Educationally speaking, there is little argument as to whether earth clays should or should not be colored with paints. The value of working with clay lies not in the ethics of candid reproduction but in the honesty of the activity. As long as the

coloring medium serves an educational purpose and is not considered a substitute for glaze, it can be considered ethical. Children want to do more than just model, tear down, and remodel. They want to finish their pieces, and in many cases finishing means coloring. Young children frequently are not concerned with or capable of glazing. This may come later as they sense a relationship between their modeling and the fired, glazed clay. Many preliminary attempts at modeling and then painting with tempera paints will and should precede glaze techniques. In fact, more often than not, the facilities for firing are not available, especially in the elementary schools.

Children should be encouraged to color their clay pieces in many different ways. They may use thick tempera paints, enamel paints, and metal oxides, which can be kneaded into the moist clay. Bisque or terra cotta, which is fired clay, may be left in its natural colors (buff, red, grey, or black), or it may be stained with various wood stains, linseed oil, or shoe polishes. Tempera-colored clay should be shellacked or lacquered, when the clay and paint are thoroughly dry, to protect the paint from being smeared. Potter's clay may be painted with tempera or showcard paints when it is wet or dry. If more than one color is to be used, children should be instructed to wait until the first color is dry before applying the second. Color, nevertheless, should be used with discrimination. The more mature student should also be given to realize that there is the conventional glaze process, which is appropriate, eloquent, and more permanent. Glazing will be discussed in detail later in the next section.

Although there is little lament over the impermanence of colored clay pieces, children become disappointed when their work is broken. Greater durability may be obtained by adding powdered dextrin to moist clay. It helps to harden the clay and makes it less likely to break under normal circumstances. Dextrin may be purchased at a drug-store, or it can be made by simply baking cornstarch at 300 degrees Fahrenheit. For good results, add one part dextrin to the equivalent of five parts of dry clay. Painted earth clays, even with dextrin added, are not to be considered durable pieces.

The principle of glazing

The composition of glaze is actually much like glass. It is a silicate-flux-alumina mixture which fuses on the surface of clayware, when subjected to a high temperature, into a hard, smooth, and nonabsorbent

surface. Glazes may be colored, transparent, translucent, or opaque. Glaze mixes that will give varying colors and glassy or matte effects can be prepared or purchased.

The technique of applying glaze to clay pieces is quite similar to that employed in applying tempera paints. The glaze may be painted on with a brush, poured over the piece, or sprayed on, or the piece may be dipped into the glaze. Pouring and dipping are the two methods more highly recommended for children since they assure a more even distribution of glaze. The glaze may be applied to greenware (unfired) as well as to bisqueware (fired). If a green piece is glazed, it is imperative that it be fired when thoroughly dry. The most advisable method for children, of course, is to bisque-fire the clay pieces and then glaze them. It is very important to handle the unfired, glaze-covered pieces with care, lest the finished product be smudged.

The chemistry of glaze making is a complicated art in itself, to be mastered only by the competent ceramic chemist. But there are aesthetic and educational values in having children mix a few of the ingredients for their own glaze formulas. The ingredients for the following glazes can be translated from grams to tablespoons in order to simplify and make possible glaze mixing for even the youngest child. By varying these formulas, many different effects may be obtained.

A Transparent Glaze Cone 06 (1841 degrees Fahrenheit)

	Parts by Weight
White lead	45
Whiting	4½
Feldspar	19
China clay	5
Flint	10½

An Opaque Glaze Cone 06

	Parts by Weight
White lead	24
Whiting	6
Feldspar	30
Calcined clay	6
Flint	11
Borax	35
Tin oxide	5

A Mat Glaze Cone 06

	Parts by Weight
White lead	32¼
Whiting	6
Flint	11½
China clay	13
Barium carbonate	5¼
Zinc oxide	4¼
Tin oxide	4¼

A White Crackle Glaze Cone 04 (1922 degrees Fahrenheit) or 02 (2003 degrees Fahrenheit)

	Parts by Weight
White lead	40
Buckingham spar	28
Colemanite	20½
China clay	6½
Flint	39
Cryolite	13
Tin oxide	21

A Volcanic Ash Glaze Cone 06

	Parts by Weight
Volcanic ash	70
Borax	30
Bentonite	5

From two to six tablespoons of various metallic oxides may be added to the volcanic glaze for the desired color. Volcanic ash is an inexpensive material that may be obtained from various parts of the country where volcanoes erupted some 500,000 years ago. The advantage of using such a product in the elementary school is twofold: one, it is rather inexpensive; and two, it eliminates the need for many ingredients in glaze formulas.

Underglaze and overglaze painting

Underglaze painting is a technique used in decorating or making a varicolored design or pattern. A mixture of equal amounts of metallic oxides and a fluxing agent, with a few drops of suspending agent (gum tragacanth or glycerine) and a few drops of water, is usually recommended. Underglaze colors are applied to green- or bisqueware and then covered with a transparent glaze and fired. When the underglaze

is applied to green clay, the piece is first coated with a thin coat of gum tragacanth—an unnecessary procedure when underglaze is applied to bisque pieces. Underglaze can be purchased or it can be prepared. Underglaze colored slips may be used in much the same manner, but it should be remembered that they are not as effective on bisqueware or as fine by nature as underglaze color.

Overglaze is different from underglaze in that it is applied only to clay pieces that have been glost-fired. The overglaze pigments are mixed with an active flux to make the color vitrify at a low temperature. Although the ceramic pieces may have been fired at Cone 06 to 03 (1841 degrees Fahrenheit or higher) the overglaze colors need only be fired just above red heat or at approximately Cone 018 (1238 degrees Fahrenheit). If they are fired at a temperature higher than 012 (1607 degrees Fahrenheit) there is danger that the color will burn out.

Underglaze crayons

One may simplify ceramic decorating for young children by obtaining underglaze crayons. They can be made, or they can be purchased at inexpensive prices from a number of ceramic supply houses. They are much like the regular school crayons and can be used to draw designs on bisqueware. Underglaze crayons are a composition of compressed metallic oxides, flux, and wax, mixed with a little gum arabic which later dries out, permitting the mixture to harden. Although they simplify ceramic decorating they are not as effective as the brush method of underglazing.

The more experienced and adventurous student who desires to obtain a greater degree of color density or soft pastel or watercolor effects may experiment with various methods of applying the crayon. Dense color may be obtained by providing a rough surface. This can best be accomplished by wetting the bisqueware with a brush or sponge. A more subtle pastel effect can be obtained by drawing directly on the bisqueware or dry underglaze. Blending, on the other hand, can be accomplished by rubbing the crayon with a moist finger, brush, or sponge.

Underglaze crayons can also be used to draw over unfired glazed surfaces, providing the glaze has been conditioned to withstand the pressure of the crayons. This can be achieved by mixing dry glaze with a gum solution. One part gum solution to three parts dry glaze plus enough water to make it applicable is usually the recommended ratio. For pieces that have been decorated with underglaze crayons it is advisable to spray over the decoration with a gum solution thus preventing the crayon designs from being smudged or eradicated.

Engobe or slip painting

Engobe or slip painting is an ancient type of decoration that is used to decorate clay bodies. It is a combination of clays made with a slip by adding water and oxides, which give it the desired color; other ingredients such as flux, feldspar, and flint are added in order to make the engobe more effective in the firing process. It can be made easily by thoroughly mixing the regular, refined potter's clay (used by children in pottery making) with water until its consistency becomes thick and creamy. For more effective results the slip may be forced through a number 40 sieve. If this is found to be impractical because of

"Clown" (clay decorated with underglaze and fired) by elementary school child. *Courtesy Madison Public Schools, Madison, Wisconsin.*

limited equipment, it may be omitted. It is still a good idea, however, to pass the slip through some type of sieve or screen.

Red clay can be used to make a slip that may be applied to a buff-colored clay body or vice versa. Colors or oxides need not be added. The colors of natural clays will contrast nicely with one another. The advantage of using the same clay for both the slip and the clayware is that shrinkage, which is sometimes a problem, is reduced to a minimum. If other colors are desired, it is advisable to add oxides to a light or white clay rather than to a dark-colored one, to be used for the slip. Clay slips are colored with the same metallic oxides that are used to color glazes. The oxides are added to the creamy slip and thoroughly mixed to insure even coloring. From one to ten per cent metallic oxide is added to the slip base, depending on the effect desired. A one-to-three

ratio may be used for dark colors and a one-to-ten for lighter colors. Since the clay affects the intensity of the engobe (clay dulls color), bright colors are usually not obtainable. The brighter slips can be procured by using clay that fires white.

Engobe is usually applied to leather-hard or nearly leather-hard clay pieces. It is applied thick with a soft brush in short strokes. The creamy consistency does not permit the long flowing strokes found in tempera painting. Young children find it more convenient to apply engobe to bone-dry clay or bisqueware. A special engobe formula with an increased amount of silica and fluxing agent is listed below for the convenience of the teacher. It is not to be used on greenware.

Engobe Used for Dry Clay and Bisque [3]

China clay	20
Ball clay	20
Borax	5
Whiting	5
Nepheline syenite	10
Feldspar	15
Flint	25

Very thick colored slip may also be applied to pottery in free or bold designs by using a rubber ball syringe, cookie-decorating bag with nozzle attachment, or a rubber bulb atomizer. This type of application gives the decoration a raised-relief, textured quality which can also be combined with brush painting. The engobe decorated pieces may be fired with or without an overcoating of clear glaze. If glaze is used, the colored slips are intensified and become lustrous.

Engobe Used for Wet Clay [4]

China clay	25
Ball clay	20
Whiting	2
Feldspar	17
Magnesium carbonate	6
Flint	30

[3] John B. Kenney, *Ceramic Sculpture* (New York: Greenberg Publishers, 1953), p. 139.

[4] *Ibid.*, p. 138.

To these formulas, add metallic oxides for the desired color in the following ratios:

Yellow	Antimony oxide	3
Green	Copper oxide	3
Blue-green	Copper oxide	2
	and cobalt oxide	1
Blue	Cobalt oxide	1
Dark Blue	Cobalt oxide	3
Purple	Cobalt oxide	1
	and pink oxide	5
Brown	Iron oxide	8
Black	Magnesium carbonate,	7
	copper oxide,	2
	and cobalt oxide	3

Underslip painting

Underslip painting is the term applied to colored slip or engobe that has been covered over with a transparent glaze before firing. The essential difference between underslip and regular engobe painting is the greater amount of glossiness in underslip-painted clayware. It is not of as refined nature as underglaze painting, which uses metallic oxides rather than colored slip.

Incised and excised decorations

The primitive method of incising a design on ceramicware is one of the most common and simple processes known today. It can be executed by the very young with nothing more than a pencil, orange stick, or modeling tool. Incising can best be done when the clay is just about leather-hard. Shallow lines or grooves are scratched or cut into the damp clay to a depth of about one-eighth or one-sixth of an inch. The edges of the design or figures are rounded or beveled with a moist finger or sponge so that there will be no sharp edges to chip or resist the glaze. Intaglio or coelanaglyphic relief are more complex variations of incised decoration.

An interesting type of incised decoration is the *mishima,* an ancient oriental method of inlay decoration used effectively by the Japanese. It is a method that may be of interest to older students. The incisions in leather-hard clay are painted over with colored slip. The surface is then scraped, leaving a light, hazy film on the clayware and dark

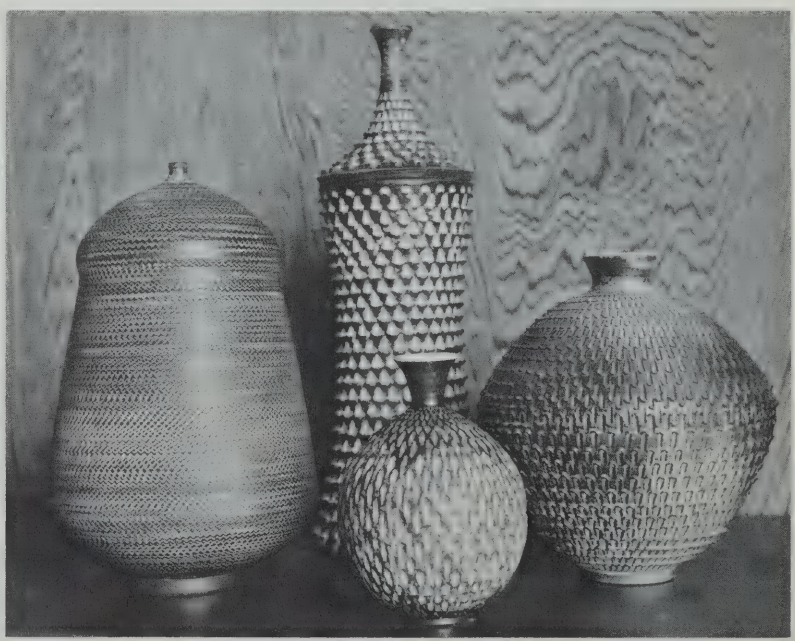
incised lines. The piece is bisque-fired, covered with transparent or semitransparent glaze, and then refired.

An excised decoration is one in which the entire background is cut away to a uniform depth, leaving the design raised and the highest portions on a level with the surface plane. A piece of sculpture with thick walls is more suitable for such a method.

Inlay design

The process of inlaying is one in which certain design areas are hollowed out to a depth of one-fourth or one-third the thickness of the sculpture's walls and replaced with a clay of nearly the same consistency but a different color or texture. The depression may also be filled with thick, colored slip and scraped off flush with the surface plane. The latter method is much easier and therefore recommended for the inexperienced potter. After bisque-firing, the clayware is covered with a transparent glaze and glost-fired.

"Ceramics in Stippled Impressions" (decorated by a variation of impressions) by Sheldon Carey, University of Kansas. *Courtesy of the artist.*



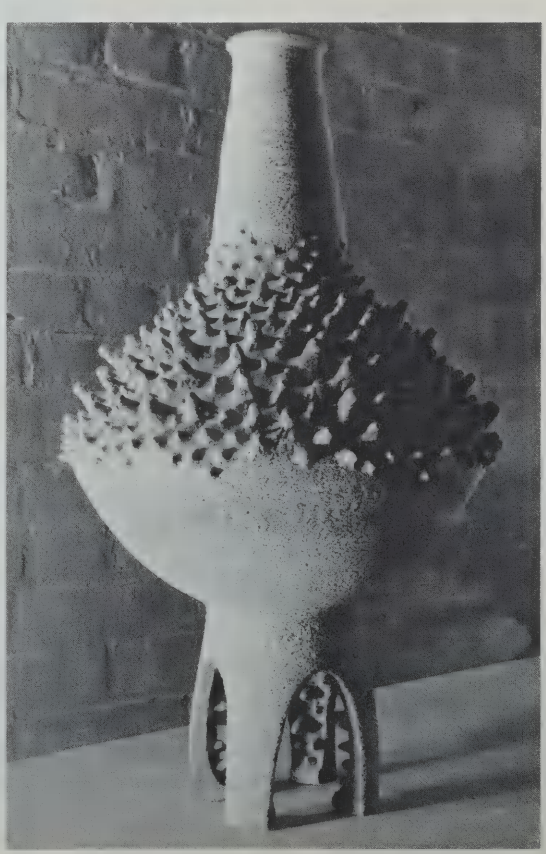
"Ebony Horse" (sgraffito decoration) by Anne Chapman, New York. *Courtesy of the Everson Museum of Art, Syracuse, New York.*

Sgraffito

This is one of the simplest and oldest types of surface decorations. It, too, dates far back into the past. A clay slip or engobe is applied to the leather-hard clay piece of a different color. When the slip is nearly dry it is scratched into and portions are scraped away, allowing certain parts of the clay piece to show through. The type of tools used to scratch or scrape will affect the quality of the design. Different tools naturally give different effects. Care must be taken that the slip does not become too dry; if it does, simply dampen it with a fine water spray. Upon completion, the entire piece is covered with a transparent glaze, allowed to dry thoroughly, and then fired. Although sgraffito can be done successfully in dry slip, it is not an advisable practice for young children since it has a tendency to chip and flake off when cut. When the process is used and the glaze begins to chip off, apply a fine spray of water over the area with an atomizer, and after a few seconds it can be scratched without danger of chipping. It is advisable to use slip, engobe, or a nonflowing opaque glaze.

Relief decoration

In this type of decoration the design is made to project from the background by modeling on the surface of the clayware. The degree of projection indicates the different types of relief. Since this is described in the section under carving, it need not be discussed here. In using relief as a form of ceramic decoration, we should refer to raised reliefs simply as "bas relief," and to those that do not project beyond the surface as "inverse relief." Medium or high reliefs are usually not appropriate for the smooth, thin, convex surface of sculptured ceramics. Perhaps the most appropriate form of relief for ceramicware is that which is a facsimile of numismatic modeling, which is flat and without undercuts.



"Thrown Sectional Stoneware Form" (grandular manganese impregnated body) by Lyle N. Perkins, University of Massachusetts *(Permanent Collection of the Butler Institute of American Art Youngstown, Ohio).*

Modeling is best done when the clay piece is not quite leather-hard and the clay to be applied is in a plastic state. It is a very good idea to score first and then to brush water on the surface of the piece to which clay is to be applied.

This relief decoration is sometimes referred to as "embossing" or applique. The model is executed, and the design is made separately and applied to the clayware by scoring and using a clay slip as an adhesive. Underslips can then be applied to the surface of greenware, or underglazes may later be applied after the piece has been fired. Both methods usually require a final transparent glazing.

"Sprig" decoration is an ancient process and one that assures uniformity of repeated motifs. Clay design may be a low relief made in a shallow plaster mold or it may be a high relief made in a deep mold. The design is applied by pressing the mold firmly to the wall of the sculpture or pottery; when the mold is removed, the design adheres to the art piece. This is a complicated process calling for a greater degree of dexterity; it is thus less likely to be used by elementary school children.

Wax resist

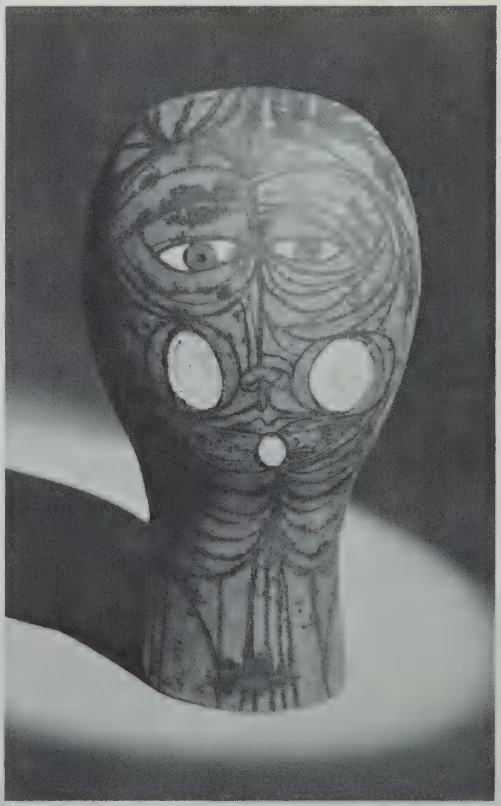
Ceramic sculpture, as well as pottery, can be decorated with the aid of a wax emulsion made of soft wax and water. This gelatinous or mucinous substance can be applied directly on leather-hard or dry clay or bisqueware with a brush, sponge, or some other transporting instru-

"Pottery as Applied Sculpture" (relief decoration). *Courtesy of the University of Kansas.*

ment. The rapid-drying emulsion is capable of resisting thin coats of glaze and engobes and will itself burn out during the glaze firing, exposing the original color of the fired clay underneath.

The adventurous sculptor may experiment with variations of this process. He may attempt crayons made with a high wax content, tallow, or rubber cement. If a rubber latex is used to resist the glaze, engobe, or slip, it is best to remove the rubber latex or "frisket" by pulling it off when the glaze is set. The reverse wax process can also contribute to interesting effects. A piece of sculpture can be completely coated with a wax emulsion and the preferred design cut or scratched through, leaving the original clay body to be available for glaze inlays. One may attempt a variation of effects by using a combination of media in various degrees of thickness and methods of application.

Left, "Thrown Stoneware Vase" (wax, sgraffito, and colored glaze inlay) by Lyle N. Perkins, University of Massachusetts *(Collection of Professor and Mrs. Joseph T. Langland)*. Right, "Thrown Head" (wax resist scratched with a pencil and painted over with black and white slip) by Fred Lucero, San Jose, California. *Courtesy of the artist.*



The Kiln and Its Operation

The firing of clayware has long been a problem for the elementary and high school art teachers. Usually the budget is not large enough to allow for a kiln, or the school's physical structure is not appropriate for the installation of such special equipment. Teachers who are fortunate enough to be located near a commercial pottery plant or a university or college with a ceramic department can make arrangements to have their students' clay pieces fired at a very reasonable charge; but many are being forced to revert to painting their clayware with tempera paints exclusively or to using clays that can be fired in an ordinary kitchen oven at about 350 degrees Fahrenheit. These specially baked clays are not as satisfactory as those capable of being fired in the kiln at high temperatures, but their use cannot be lightly dismissed. They can still be considered an excellent medium for beginners and low-budget departments. However, no elementary or high school should be without its own ceramic kiln.

The temperature range in most ceramic kilns usually runs from 1238 to 2759 degrees Fahrenheit. For pottery, a kiln that fires at cone 04 (1922 degrees Fahrenheit) is needed. A kiln formerly was the most expensive item in an art department and utterly impossible for many schools to have; but today, commercial companies have been able to produce many convenient kilns, of varying size and types, at reasonable prices. As the electric kiln is the best and most economical for the elementary and high school programs, the following discussion deals with it exclusively.

There are several small portable kilns available today which have replaceable nichrome metallic elements that will fire up to 2000 degrees Fahrnheit. They are usually priced from $30 to $100 without a pyrometer (an instrument for measuring the temperature). The pyrometer usually costs an additional $25. Should the teacher wish to cut down on his expense, pyrometric cones may be used instead of the pyrometer. Such cones are made of various proportions of clay and fluxes calculated to melt at defined temperatures and are relatively inexpensive. They are placed inside the kiln and watched through a peephole. When they tire or collapse, the kiln is turned off and allowed to cool slowly.

Portable kilns have a firing chamber of approximately 14 inches by 14 inches by 14 inches, come already assembled, and can be installed

by simply plugging them into a regular 110-volt household socket. They are available with either top- or side-loading doors, the top-loading door having the advantage of possessing heating elements on four sides so that there is more even distribution of heat. These kilns are safe, free from gases, quiet, easy to operate and to clean, require no flue, and are most efficient.

Preparing a new kiln for use

The portable kiln, like all equipment, should be located in the most convenient place, not too near a sink or too near walls that are not fireproof. It should be placed on a low, sturdy stand for convenience in loading and unloading. The appropriate kiln furniture is also needed, that is, stilts, refractory shelves, pyrometric cones or pyrometer, shelf supports, and kiln wash.

All new kilns should be pretested and their reactions charted for future reference. Anyone who is to fire the kiln should be thoroughly familiar with its action. To obtain an accurate and reliable reaction, the kiln should be tested with a full load of ceramics. Before the first test-fire, it is a good idea to give the kiln a preliminary drying out by running it at a low temperature for a few hours.

Before the first glost-firing, the kiln's shelves and floor should be painted with a thick coating of infusible kiln wash—equal amounts of china or fire clay and flint, mixed with enough water to achieve a creamy consistency. This is to prevent glaze droppings from sticking to the shelves or kiln floor. The sides of the kiln may be coated, if desired, with a thinner application of kiln wash. Any teacher who anticipates the purchase of a kiln should consult a competent ceramist to help him determine the kiln best suited to his purpose. Should his needs call for a kiln with special wiring (220 volts), he should consult with the school electrician to make sure that the school's wiring is adequate or that it can be adapted without too much additional expense. Special wiring can sometimes run into hundreds of dollars.

Firing the kiln

Each kiln should be carefully stacked with the pieces to be fired. If they are greenware, they may be placed quite close together, and, in fact, may even touch or be placed one inside the other. Care must be taken, however, to avoid excessive weight on the lower pieces. Glazed pieces should be stacked at least a quarter of an inch apart to prevent

their sticking together. The bottom or foot of the ware should be free from glaze or carefully placed on stilts, and all pieces must be thoroughly dry.

The kiln should be heated gradually in order to eliminate any chemical moisture remaining in the bone-dry clay. The temperature is increased by turning the control from low to medium and finally to high, or in the case of a kiln with a series of controls, by turning successive switches at various time intervals until all heating units are in operation. Care must be taken not to fire too rapidly; it should take approximately eight hours to fire a small electric kiln to cone 04. Larger kilns will naturally require more time. Glost-firing may be more rapid than bisque-firing. When the desired temperature is reached, the kiln is turned off and allowed to cool, preferably overnight. If the kiln is opened prematurely there is danger of cracking the clayware. The opening of a successfully fired kiln is indeed a delight to behold.

Other Plastic Media

There is a variety of modeling media being used in the elementary and high schools today ranging from the nonhardening cohesives to the rapidly self-hardening clays. Perhaps the most widely known man-made clay is plasticine. This is an industrially prepared clay that never hardens. It requires no special care, is easy to use, and has the advantage of being reusable time and time again. It can be purchased at many department stores, but the better grades are available at art supply companies only. The Italian plasticines are definitely the best. They are usually composed of tallow, pumice, powdered sulphur, native Italian earth clays, and varied plasticizers such as petroleum derivatives or linseed oil. Italian plasticine has less tendency to dry out than other less expensive brands. In spite of its pliability, one of the disadvantages of plasticine is its characteristic of being lifeless and, therefore, less appealing to very young children. Another disadvantage is its tendency to stiffen in cold weather. If the clay is too stiff, however, it can be placed near a warm radiator or register and it quickly becomes quite pliable.

In addition to plasticine, there are other different types of homemade cohesives such as papier mâché emulsions, sawdust mixes, and cornstarch-salt, flour-salt, sawdust-flour, or dough clays. The formulas for some of these are listed on page 62.

Cornstarch-Salt Clay

1 cup common table salt
½ cup cornstarch
½ cup boiling water
Add food coloring as desired.
Add cologne or oil of cloves for fragrance.[5]

Flour-Salt Clay

1⅓ cups sifted flour
1⅔ cups noniodized salt
1¼ tablespoons alum powder
Add ¾ cup of water.
Color if desired.[6]

Sawdust-Flour Clay Formulas

18 cups sawdust
16 cups flour
6 tablespoons salt
Add boiling water to desired consistency.
Makes 38 orange-sized balls.[7]

3 cups sawdust
1 cup wheat paste
Enough water to mix ingredients together
Do not make it too stiff.
Use before it hardens.[8]

2 cups sawdust
1 cup plaster of Paris
2 cups wallpaper paste
2 cups water[9]

[5] Estelle H. Knudsen and Ethel M. Christensen, *Children's Art Education* (Peoria, Ill.: Charles A. Bennett Company, Incorporated, 1957), p. 119. Reprinted by permission of the copyright owner.

[6] *Ibid.*

[7] *Ibid.*, p. 167.

[8] Margaret H. Erdt, *Teaching Art in the Elementary School,* rev. ed. (New York: Holt, Rinehart & Winston, Inc., 1962).

[9] *Ibid.*, p. 67.

"Cowboy" (papier mâché) by second-grader, Olympic Hills School. *Courtesy of the Seattle Public Schools, Seattle, Washington.*

Dough Clay

2 cups flour
1 cup common table salt
1 tablespoon powdered alum
⅓ cup water
Powdered tempera for desired coloring

Papier Mâché Emulsion

Pour a mixture of cornstarch and cold water into boiling water while stirring to a creamy consistency. Add paper confetti until stiff enough to model. Allow to cool.

Carton Pierre

Mix paste and scraps of paper, and boil to a pulp. Add color as desired. Allow to cool before using.

Plaster as a modeling medium

Plaster of Paris is fast becoming one of the most extensively used materials in the elementary and high school art programs, in spite of the fact that great precautions must be taken when using it in classrooms not especially designed for art work. Its educative merits, however, compensate for the added care one must take in guarding against plaster being tracked over the floor and possibly being poured down the drain to play havoc with the plumbing. An ounce of prevention [10] can make the use of plaster a pleasurable addition to the art teacher's educational repertoire. With all its inconveniences, it still has its advantages. It is inexpensive, universally available from lumber companies, easily prepared, and can be modeled in its pliant state or carved in its solidified or compact form. Since plaster of Paris is a tricky substance to use, it is important that the teacher understand something about its characteristics.

The practice of modeling with gypsum dates back to antiquity. The plaster of Paris used by art teachers today is a derivative of the same

[10] Be sure that plenty of newspapers are available to cover the desks, table, and floor; that excessive plaster is disposed of in wastebaskets and not in the sink, even if the sink has a plaster trap; and that a piece of window screen is placed over the drain as an added safety measure.

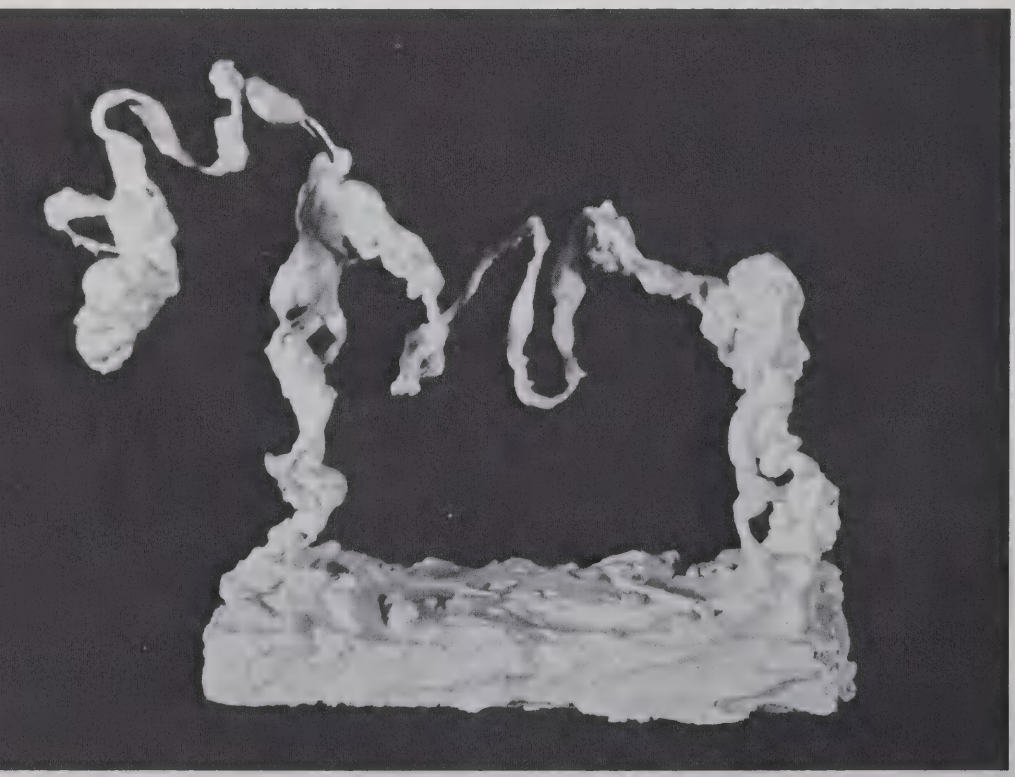
"Lion" (plaster) by a college student, Syracuse University.

substance and is used in much the same way. It is an industrial product prepared by calcinating gypsum by subjecting it to a temperature of 350 degrees Fahrenheit. Plaster of Paris ($CaSO_4H_2O$) can be combined with one-half of its original water content to become a fast-setting, pliable medium. Plaster of Paris, or potter's plaster as it is sometimes called, is prepared for modeling by being sifted into an equal volume of water. This is best done by sifting the powdered plaster through the fingers uniformly over the surface of the water, being careful not to drop handfuls into the water. Stir gently with the hand, a large spoon, or a mixing paddle. Allow the creamy substance to set to the consistency of paste. It is then ready to be modeled over a framework of screen or hardware cloth. Since it sets rapidly, only small amounts should be mixed at one time, allowing it to be used before it hardens in the bowl.

Plastic or rubber bowls are highly recommended for use in mixing plaster. Half of a large rubber ball will make an excellent mixing bowl. The excess plaster that has hardened can easily be removed from such bowls by forcing the walls to collapse, cracking the nonelastic plaster.

Retarding Agents Plaster becomes viscous as the setting progresses, until it is finally solidified. This takes approximately thirty minutes. Since it sets so rapidly, retarding agents are needed to increase the time required for setting in order that it can be used as a modeling medium for children. Cold water, although not the most effective retarder, is the most economical and safest. For more effective retardation

"Hawk" (plaster) by a high school student. *Courtesy of the Summer Art Workshop for High School Students, Syracuse University.*



one may use saturated solutions of borax, sugar, calcined lime, or various other organic substances. Adding parts of lime putty to each part of plaster not only retards the setting time, but also increases plasticity. The caustic nature of lime derivatives, which may possibly come in contact with human tissue, however, makes their use in the lower grades of a public school program a precarious one.

Accelerating Agents Although acceleration of the setting of plaster is rarely needed, there are a few highly appropriate agents worth knowing about. The simplest and most common method is to vary the ratio of plaster to water. Low water content accelerates the setting process and helps to harden plaster. High water content retards setting, but also reduces its strength. Warm water, common table salt, potassium, alum, and potassium sulphate are also considered good accelerators.

Hardening Agents The soft, chalklike nature of plaster, which is undesirable, usually calls for some type of hardener. Gum Arabic, Portland cement, and dextrin are interior hardeners that do not disturb the texture of the plaster and yet prevent it from being too soft and flaky. Skimmed milk mixed with water and powdered plaster will not only give plaster strength, but also will give a surface which, when thoroughly dry, can be rubbed and polished to look almost as smooth and lustrous as marble. Asbestos, absorbent cotton, hair, and hemp are but a few organic substances that may be used to give cohesive strength to plaster, but they may modify the texture as well. There are also surface impregnators which are used to render the finished piece more durable. Prepared shellac and varnish mixtures, described under the heading "Coloring Plaster of Paris," as well as bicarbonate of soda, lime water, aluminum sulphate, oils, waxes, and paraffins are highly recommended. (Specific directions for coloring plaster of Paris may be found on page 78.)

PART
TWO

Carving

The art of carving, one of man's earliest art activities, is as fascinating to children and youths as modeling. It, too, involves the fashioning of images in three dimensions. The primary difference, however, is that in modeling one starts with nothing more than an idea and, using the "additive" process, applies clay upon clay until he objectifies his thoughts or ideas. When one carves, he usually starts with a hard substance and eliminates the superfluous material until the desired end is achieved. Carving, like modeling, if properly executed, can be a genuinely

creative process. It permits the student to experience volume and mass, to evince personal potentials, and to satisfy his need for self-integration.

Unfortunately the art of carving has remained a rather limited activity in the public and parochial schools. Far too many teachers have been indifferent to this type of sculpture, perhaps because of certain misgivings. Carving seems highly complicated and quite remote. It is often thought of as a somewhat mysterious process involving magical occurrences and expensive materials and equipment. It may be true that carving is the most difficult of all the sculptural processes, but there are methods and techniques that bring the art of carving within reach of elementary and secondary school students.

There is no doubt that such sculpture requires equipment and materials that are relatively more expensive than those we have used in many other school programs. It requires more space, but in fact less space than industrial arts, home economics, and physical education programs. With the innovation of simple and appropriate techniques, many inexpensive carving materials that lie within the capacities of all school children have been made available to the art teacher.

Carving materials are generally thought of as hard and durable substances such as wood and stone, but there are many inexpensive and appropriate materials that can be used by children. Some sculptural materials suitable for carving are soap, plaster of Paris, styrofoam, salt blocks, pumice, fire brick, balsa, and blocks of dry as well as moist potter's clay. Styrofoam, soap, pumice, and blocks of moist clay are the easiest media to use for carving and undoubtedly the most suitable for the younger children. Plaster, brick, balsa, and aggregate mixes [1] are more engaging and are, therefore, more appropriate for the older students. The adolescent, nevertheless, will find that the more resisting and challenging media, such as wood and stone, satisfy his craving for energy-consuming activities. For this reason these materials are more conducive and valuable to the high school program. We too frequently have a tendency to insult the adolescent's sense of capability and maturity by underestimating what he can accomplish. He is at an age when he is beginning to compare himself to adults and should be allowed the experiences that will meet his needs and potentialities and accord status to him.

[1] Aggregate mixes are formed by combining plaster of Paris and an inert material such as sawdust, vermiculite, zonolite, sand, or brick particles.

Carving is not as difficult as many would assume it to be. With simple techniques afforded by a variety of materials and with sympathetic guidance, it can be mastered with relatively little skill and a minimum of tools. The inexperienced usually dread the beginning of carving. Confronted with an undefined mass, they experience incomprehensibility. They frequently find it difficult to envision their ideas within the solid mass or block. It is for this reason that the carving of a mass of moist clay or a block of some appropriate soft material such as soap or styrofoam is recommended as a starting point. The beginner is usually also possessed with a fear of breaking the piece or of cutting too much away. This fear, however, is not a well-founded one, for such accidents are very seldom. Should such a mishap occur, it can be remedied easily by making slight adjustments or simple corrections. As long as the student carves the block as a whole, working on all sides simultaneously and being careful not to cut too much away at any one time, success will prevail.

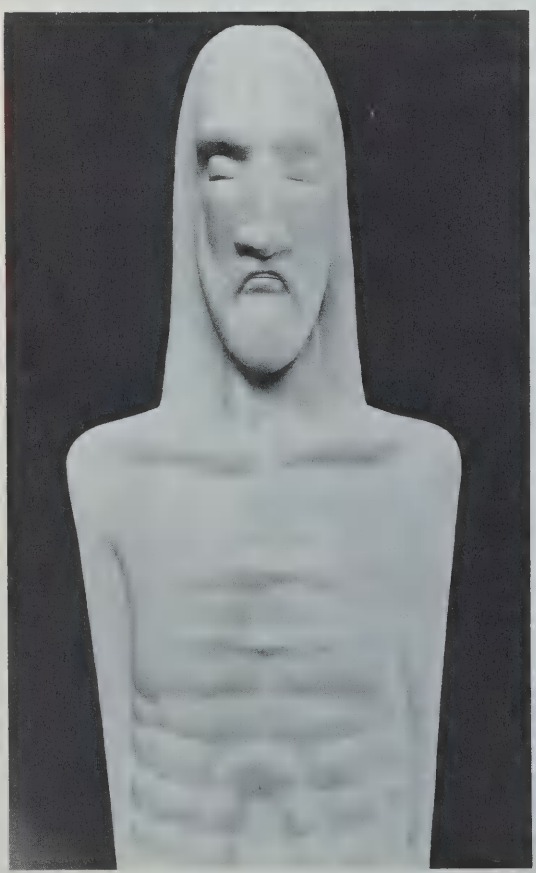
Plaster of Paris.

Aggregate Mix.

Sculpture in Plaster of Paris

Plaster of Paris is probably the most suitable material for carving that can be used in both the elementary and high schools. It is inexpensive and can be carved with a relatively simple tool. Students have had success using paring knives, sloyd knives, and pocketknives as well as screwdrivers, linoleum cutters, and nail files. If a smooth surface is desired, the finished piece may be rubbed lightly with sandpaper. Plaster blocks can be made easily by pouring liquid plaster into cardboard containers and allowing it to set until hardened.[2] The cardboard

[2] The preparation of plaster of Paris may be found on page 67.



"Christ in Resurrection" (detail) modeled in plasticine and cast in plaster by the author *(private collection)*.

can be stripped away when the plaster block is still moist. Although the block can be carved in either its moist or dry state, it is recommended that it be kept moist during the carving process. Should the block become dry, it can be remoistened by wrapping damp cloths around it or by placing it in a damp atmosphere.

"Sleeping Bird" (carved plaster) by a college student, University of Wisconsin.

Procedure

Once the block is prepared and the student is cognizant of his intention, the teacher should have him begin by roughly sketching the image on all sides of the block as well as the top. Crayon, chalk, charcoal, or even paint may be used. These sketches are intended to guide the student in cutting off the surplus material and defining the created image. As the carving progresses, the student will find it necessary to resketch the proposed image from time to time. Sculptors frequently carve into the block without the aid of preliminary sketches. Such direct carving in the hands of an experienced artist results in sculpture with great vitality. This method, however, is not recommended to the amateur sculptor who needs some preliminary form of improvisation. On the other hand, these rough sketches are intended merely to serve as a guide and are by no means to be followed explicitly.

It is usually necessary to curb the beginner's imagination, for generally his ambitious ideas are a little too complicated for his technical abilities. The beginner in sculpture often has great difficulty in relating his idea to the material to be used. For this reason the teacher should assist him, even at the risk of limiting his freedom of expression, in selecting a subject that can be represented in a simple, compact form. Since plaster of Paris is a relatively fragile and inflexible medium, the teacher would do well to guide the student in adapting his idea to the massive quality of the plaster block. This should not limit the student, but, on the contrary, it should help him to envision and crystallize his ideas and to incorporate them into the medium at hand. A pelican, for instance, with its long, narrow neck and delicately thin legs may be extremely difficult, if not impossible, to carve, unless designed in such a way as to avoid delicate structure. White Pelican on page 123 is an example of a compact composition conducive to carving.

Plaster carving is more direct and more quickly accomplished than either wood or stone. It is, therefore, imperative that the student be

reminded to turn his block constantly, working on all sides simultaneously and being careful not to cut away too much on any one side. He should be taught to begin by first removing the unwanted large areas of the block, roughing out the intended form. He should carve slowly and with great deliberation, taking away just a little of the plaster at any one time. The student should be reminded to move around the image as he carves, keeping all parts of the sculpture progressing equally, for only in this way can be envision the sculpture as a whole. He should be encouraged to pause and study his progress and to ponder each successive move. Moreover, he should feel free to make minor alterations and meaningful corrections whenever he deems them necessary, and above all else he should be aware that the hasty removal of large areas and premature consideration of details and refinement usually distort the image and result in bad sculpture.

The most natural method of creative carving is to study the image at each stage of its progress in terms of one's own expressive reaction to an idea. To be concerned with the subject and to begin to define details after only the rough form of the image emerges from the amorphous block would be most unfortunate. From the very moment that an idea demands expression, from the preliminary drafts and rough blocking out to the extremely refined finishing touches, the creator must constantly be relating emotions to ideas. There should be no aesthetically inactive work periods.

The young student should be permitted the freedom to experience what he can or cannot do with plaster of Paris or some other medium, such as salt blocks, ceramic fire brick, soap, and various aggregate mixes. He can become proficient and achieve a feeling of self-satisfaction in carving if he is given proper guidance and permitted considerable freedom. To experience designing in mass and volume, even in the most unsophisticated fashion, is the beginning of sculptural wisdom.

Coloring plaster of Paris

The natural appearance of plaster of Paris is stark white unless it is precolored by the addition of pigments to the liquid mix. And although colorless plaster can be most attractive, it usually profits greatly when given a beautiful patina. If color is desired, it can be obtained by either adding pigment in wet or dry form to the liquid plaster at the time the block is being made or by applying a patina to the carved piece. Before applying color to the surface of the plaster model, it is necessary to allow plaster to become bone dry. The surface pores are then sealed by brushing a mixture of one part shellac or varnish to ten parts alcohol or turpentine over the model. Shellac or varnish mixtures should not be applied to wet plaster because there is a tendency for them to flake or peel off. Tempera paints are the most economical and convenient coloring agents for elementary school use. The liquid form may be applied to the sized plaster model after the surface has been treated and allowed to dry thoroughly. The colored piece is given a final protective coating of shellac mixture to prevent it from blotting when handled. Older children are capable of applying dry, powdered pigments to the surface after it has been brushed with a mixture of shellac and alcohol; usually a piece prepared in such manner will need no additional protective coating.

"Female Figure" (plaster) by a college student, Syracuse University.

Sculpture in Wood

Carving in wood can be fairly difficult for the beginner; however, for those who have had the opportunity to model in clay and carve in plaster, experiencing an understanding of form and technique, woodcarving can be a gratifying adventure.

Children in the upper grades are usually capable of carving wood, especially if it is carefully selected to fit their ability and physical strength. Balsa, which has been mentioned previously, does not offer the true carving experience usually associated with wood sculpture. Therefore, it is not considered one of the traditional woodcarving media. Hardwoods, on the other hand, are far too resistant for the developing muscles of the young preadolescent. Such woods require the use of traditional carving tools, which must be kept sharp, and for this reason can be considered potentially dangerous for the young artist. Carving hardwoods does, however, add to the aesthetic development of the individual. It presents challenging sculptural problems and demands greater patience and dexterity. Although it requires more physical strength and energies than most preadolescents possess, it can be an appropriate activity for the more mature student. With proper guidance, the adolescent and a few preadolescents can gain considerable skill and knowledge from the experiences of carving such hardwoods as oak, walnut, maple, and mahogany.

Regardless of the variety of the wood used for carving, the student, or in the case of the younger children, the teacher, should be concerned with selecting a compact, durable wood of even, smooth grain. It should be a piece that is not too large. For the beginner a piece approximately 4 inches by 4 inches by 18 inches is highly recommended. Since wood expands and contracts under certain atmospheric conditions, developing checks and cracks, it should be well seasoned. The best woods are those that have been naturally dried with hot air or in a kiln.

Since carving is a manual activity resulting in a tangible product, it is dependent upon materials and equipment. It is best, therefore, to discuss various woods, tools, and other pieces of necessary equipment in terms of their appropriateness before going into the procedure of carving.

"Mask" (wood), Gabon, Fang Tribe. Photographed by O. E. Nelson. *Courtesy of Mr. and Mrs. Henri Kamer, New York.*

Wood carvings by high school students. Left, *courtesy George Benedict, West Genesee High School, Camillus, New York;* and center and right, *Elizabeth Lester, Chenango Valley Central School, Binghamton, New York.*

Characteristics of wood

There are many advantages of using wood as a sculptural medium. Next to plaster of Paris, it is the most suitable material for carving by school children. There are varieties of wood that satisfy the needs of the novice who requires ease of cutting, and there are more durable woods for those who seek a challenge to their skills. Wood is available in just about any part of the world. It can be purchased at a reasonable cost at any lumber company in either plank or bulk form. In fact, it can be found frequently along river banks and roadsides. Another advantage of using wood is that it does not require great space and is not an extremely messy medium. The smaller pieces can actually be carved in the regular classroom or at home.

Wood is an alive, warm, and vibrant medium and can be adapted to a variety of subject matter. Its natural beauty and tactile quality have attracted sculptors for thousands of years. It is light in weight, even lighter than a piece of plaster of Paris of comparable size and certainly much lighter than stone. It comes in a wide range of sizes, textures, and colors.

Among the soft woods that may be carved by the preadolescent and the amateur artist are the easy-to-cut evergreens such as soft pine and cedar. Those that are a little harder to work with are hemlock, redwood, cypress, spruce, and fir. Classified as the hardest evergreens in the softwood category are the larch, western pine, and yellow yew. There are also a number of deciduous trees that produce good softwoods for carving. Those most frequently recommended are basswood, poplar, soft birch, and maple, as well as the fruitwoods, especially apple and pear.

For the experienced student who has a strong desire to test his skills and proficiency, there are more suitable hardwoods that demand greater strength and physical dexterity. He should be encouraged to carve first in cherry, teakwood, walnut, mahogany, chestnut, sycamore, cottonwood, elm, ash, gumwood, or honey locust. If he feels more adventurous, he may attempt to carve a piece of oak, hickory, black locust, hard maple, or the Spanish variety of mahogany. Beautiful but not easily obtainable woods that should be considered by the more professional carver are the rare, tropical woods such as snakewood, ebony, cocobola, rosewood, zebrawood, and lignum vitae.

The carving workability of a piece of wood should not be the only criterion for its selection. There are other characteristics such as color, texture, and response to various finishes that should be taken into consideration. It is for this reason that the following descriptions are are given. The list is far from complete. It is merely intended to present those that are more generally used and most frequently available.

Applewood is a light wood available in many varieties. The imported ones are much more beautiful than our domestic types. The wood is rather soft and close-grained and is suitable for carving small pieces of sculpture. It takes a good finish and is recommended for beginners as well as experienced carvers.

Ash is a medium-durable, heavy, hardwood which is light in color but may also be found in grayish-browns. It is usually found with the oaks, maples, and hickories. Its open grain makes it a difficult wood to carve and to finish. Baseball bats are usually made from ash. It is recommended for the more experienced carver.

Birch comes in a variety of types, most of which are durable, hard, and strong. White birch is not as durable as some of the others, but its soft wood is most suitable to the beginner's style of carving. It is reddish-brown in color, heavy, and

close-grained. Birch is a small, northern tree found in New England, the Great Lakes region, and most of Canada. Red, or river birch is found in most southeastern states.

Basswood is one of the easiest-to-carve hardwoods. It is light in weight, fine-grained, creamy white in color, and fairly compact. It is recommended for carving small pieces, and since it can be carved with little effort, it is very good for the beginner. Many of our toys are made from American basswood.

Butternut or white walnut is a coarse-grained, medium-hard, light-colored wood. It is easily carved and takes a very high polish. Many sculptors prefer it to black walnut because it is softer and easier to manipulate. The butternut tree is found in Ohio and the surrounding states.

Cedar is one of the softest woods to carve. It is a light, fine-grained, and fairly durable wood. The colors of cedar vary from a light yellow to a dark brown. Its scent makes it pleasant to carve. It is highly recommended for the beginner.

Chestnut is a lightweight, soft, cream-colored wood. It is fairly durable and easy to carve, but susceptible to checking and warping. The chestnut blight, years ago, has made the tree extinct in America. Only the dead trees remain standing, pitted and perforated by insect holes, and thus not very suitable for carving.

Cherrywood is one of the harder fruitwoods. It is a close-grained, compact wood, reddish in color, and excellent for carving. It is frequently used for furniture and is highly valued for wood engraving in printmaking. Cherry trees grow in all the eastern states and as far west as the Mississippi River.

Cypress is a fairly soft, but durable wood very resistant to rotting. Its close, straight grain makes it a good wood for beginning carvers. The bald cypress is found in Florida, the states bordering the Gulf of Mexico, and in the eastern parts of Georgia, Alabama, and South Carolina.

Cocobola is a tropical wood found largely in South America. It is a beautiful, soft red in color, very hard and dense, and far too difficult to carve for most students. Its suitability for sculpture, however, merits the consideration of the experienced carver.

Ebony is a tropical hardwood that receives much attention from sculptors and craftsmen. It is a smooth-grained, heavy, jet-black wood. Although usually black in color, there are also red and green varieties, which finish into attractive pieces of jewelry as well as sculpture. Most ebony is imported from the Dutch East Indies, but some comes from Africa and South America. It is a difficult wood to carve and, therefore, not recommended to the novice.

Elm is considered a tough hardwood, difficult to work, and therefore rarely used by wood carvers. It is of medium weight, durable, and ranges from a light warm to dark brown in color. Elms are found in the eastern part of the United States. It is not a suitable wood for beginners.

Fir is one of the hardest of the evergreens. It is much like spruce in appearance and cutting characteristics, and is readily available. Balsam fir is found in the Northeast and Canada. Other species are found in the western mountains. Beginners find it easy and enjoyable to carve.

Gumwood is light and fairly durable. It is a beautiful grayish-brown to reddish-brown in color. It checks, cracks, and warps in seasoning and is difficult to carve. Although it is an attractive wood, it is not recommended to the young sculptor.

Hickory is a domestic variety that is strong, elastic, and difficult to carve. It comes in various shades of colors ranging from white to dark brown. It is frequently used for articles that require a light, tough wood. The hickories are found in the central eastern states. It is not a good wood for the novice carver.

Holly is a very fine, close-grained, medium-hard wood. It is compact, light in weight, easily carved, but unfortunately not usually readily available. The American holly, which grows to a height of 50 feet, can be found in the southeastern states.

Lemonwood is a yellow or yellowish-white hardwood. It is a fine, straight-grained wood, usually available in large pieces. Draftsmen use it extensively for archery bows.

Lignum Vitae is a very popular wood among the more experienced carvers. It is considered the heaviest and most dense of all carving woods. Its hardness makes it extremely difficult to carve, but once carved and sanded, it takes a very high polish and shines elegantly. Much of this is attributable to the natural wax content of the wood itself. Lignum vitae is imported from Cuba, Puerto Rico, and South America. Like most varieties of tropical woods, it is fairly expensive.

Maple is classified among the medium hardwoods. It is a close-grained, compact wood fairly common in America and readily available. The finished results are attractive and gratifying. Maples are found in the East, with the exception of Rocky Mountain Maple and the Broadleaf Maple, which are found in the West and Canada.

Mahogany is a beautiful golden brown to reddish-brown wood that takes a high polish nicely. It is fine-grained, durable, of medium weight, and fairly inexpensive. Unfortunately it is brittle and likely to splinter. It requires a sculptor with experience and patience who will take great care in carving.

Myrtle is a fairly hard, dense, and strong wood which takes a fine polish. It is yellowish in color with a dark gray or black grain running through it. It is a beautiful wood, one that is recommended to the experienced carver. However, it is not always available.

Oak is a hard, heavy, durable, close-grained wood. It is highly susceptible to checking, cracking, and warping, but in spite of these characteristics it is an excellent carving wood, especially if treated in broad and massive forms. The wood is light in color, coarse and tough, and very hard to handle. It is not recommended to amateur carvers.

Poplar is a soft, lightweight, yet durable wood. Its color ranges from a light to a dark tan, which results in a beautiful finish. Most poplars are very easy to carve and highly recommended to the beginner. Yellow poplar, however, is a little difficult to cut and should be reserved for the more experienced student. Poplars are found in the northern part of the United States and southern Canada.

Pearwood is much like applewood. It is light in weight, close-grained, and fairly soft. It carves well, permitting delicate detail, and is available at most lumber companies. The finished piece should be given a protective coat to enrich its quality.

Pine is a lightweight, soft, even-grained wood. It is frequently recommended to the beginner. The pieces carved are likely to be more successful if carved in a crude, broad, and simple manner. Pines are available in a yellowish to a reddish-brown color.

Redwood is a fairly soft, brittle, aromatic wood. It is lightweight and easy to carve. Redwood, as its name implies, is a reddish-brown wood that takes a good polish. Redwoods, which for the most part are protected in National Parks, grow on the Pacific Coast. It is highly recommended to young carvers.

Rosewood is a tropical hardwood, red to reddish-brown in color, with streaks of yellow or black running through it. Like most woods from exogenous trees, the rosewood is hard, durable, and difficult to carve. In its finished stage it has a beautiful appearance. Most rosewood is imported from Honduras, Brazil, East Africa, and Madagascar.

Snakewood is a durable hardwood that comes from Dutch Guiana. It is a warm reddish-brown in color with spots to darker colors, giving it a reptile-like appearance. It is not recommended for the beginner, but is most suitable for the experienced sculptor.

Spruce is a soft wood that does not require much physical exertion. It is an excellent carving wood, especially for the beginner. It can be obtained in logs suitable for small pieces of sculpture. Spruces are to be found in the North and along the Alleghenies.

Sycamore is a close, coarse-grained, yellowish to brown, light in weight hardwood. It has a tendency to check and warp in seasoning and is fairly difficult to carve. American sycamore is found in the southeastern states and also in Arizona and California.

Teakwood is quite hard, rough, and porous in texture. It is a strong, even-grained wood that carves fairly easily in spite of its strength. Sculptors like its dark chocolate-brown color which darkens even more with carving and polishing.

Walnut is a close-grained, durable, dark wood that takes a high polish resulting in a beautiful finish. Its texture and fine grain qualify it as one of the finest sculptural woods for experienced carvers. The colors vary from a light to a dark brown, which can be made even darker by rubbing down with linseed oil. Walnut is a domestic as well as an imported wood. It is prevalent in the Midwest and is generally available in log and plank form. It requires very sharp tools, experience, and strength. For these reasons it is not recommended to the beginner.

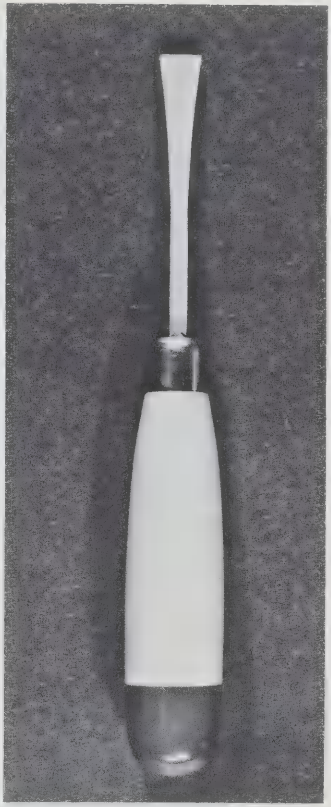
Yew is a fine-grained wood. It is a very hard wood, difficult to carve, but highly acceptable. It is excellent for archery bows.

Zebrawood is one of the hard, tropical woods that come from Africa and is not, therefore, readily available. It has a striped grain which can be enhanced with the proper finish. Zebrawood is not recommended to the beginner.

"Genesis," a study in wood forms by a college student, Syracuse University.

"Icon" (wood) by Raymond Musselwhite, North Carolina State. *Courtesy of the artist.*

Raymond Musselwhite created this impressive totem with massive planks of hard wood held together with a series of nuts and bolts. Its setting has been carefully considered by Professor Musselwhite. The character of "Icon" and the rural environment are certainly compatible.



A quarter-inch wood chisel. On page 90 are a set of wood gouges and an experimental wood block cut by an industrial design student on a band saw. *Courtesy Industrial Design Department, Syracuse University.*

Tools and equipment

The tools used for wood carving are simple and easily procured. A pocketknife will do well for cutting small pieces of soft and easy-to-carve wood, but for our purpose a pocketknife alone will not suffice. There is a great advantage in the appropriateness of tools. Although there are literally hundreds of tools of different shapes and sizes, the beginner is not likely to use more than three or four. The more experienced carver, however, may need approximately a dozen, while the professional carver usually requires as many as thirty or forty fundamental tools.

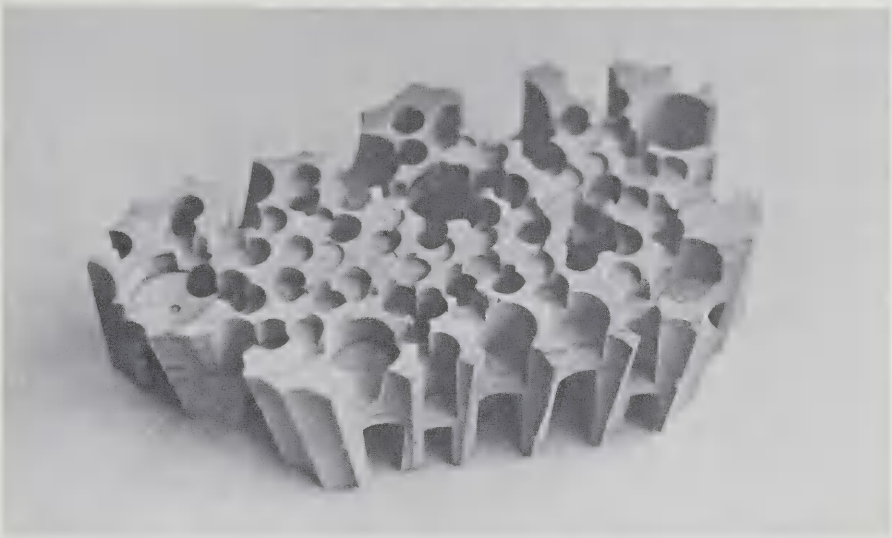
The following basic tools may be found sufficient for the student in the elementary and secondary schools: a quarter-inch straight chisel, a spade-shaped gouge, and a quarter-inch shallow gouge. The quarter-

inch straight chisel is perhaps the most important of all tools. Others such as the "V" or parting tool, veiner, carver's chisel, and deep gouges may be added as the carver's ability to handle complex ideas develops and his needs become more demanding.

Whatever tools are used, it is imperative that they be kept sharp at all times. Since dull tools tend to crown the grain, marring and bruising the wood, it is especially wise to use extra-sharp tools when carving the soft woods.

The student may also benefit from rasps, rifflers, and occasionally from a router. He will also need a few sharpening carborundum stones, oil, and possibly sandpaper, wax, and stains to finish his wood carvings. A definition of the various tools may be found in the glossary.

In addition to the cutting tools, the sculptor needs certain other pieces of equipment that will contribute greatly to the success of his efforts. If cutting is to be done on a classroom desk, it is advisable to use a well-constructed jig. Without the jig the student is likely to mar the desk and, possibly, injure himself. Even when using the jig, it is advisable to cut away from the body, with the free hand well behind the cutting tool. Naturally, a carpenter's bench would be more appropriate. In the secondary schools and colleges where such equipment is



An experimental exercise by an industrial design student using a power drill. *Courtesy Industrial Design Department, Syracuse University.*

a matter of course, the sculptor's bench should be made of sturdy, hardwood, 2-inch planks and 2-inch by 4-inch legs, equipped with a heavy woodcarver's vise which is used to hold the piece of wood while carving.

There are, however, other, less-expensive methods of securing the wood. "C" clamps, which come in many sizes and are within the budget range of any school system, can be most effective. Metal vises may also be used. If a metal vise is being used, care must be taken to insert pieces of soft wood between the sculpture and the jaws of the vise to prevent the sculpture from being marred. There is also the method of securing the wood by inserting a hand-screw through the bottom of a large plank and into the sculpture. The plank acts as an anchor. Some sculptors prefer to use a barrel of sand. The piece to be carved is placed on top of the sand, which holds the piece firmly and, at the same time, permits the carver to change easily the position of the piece, facilitating the carving. Extra large and heavy pieces, of course, need no securing.

A wooden mallet is another necessity. Although not indispensable for small carvings, it is certainly needed for the larger pieces. A large mallet made of lignum vitae or some other hardwood is used to block out the heavy work. Smaller and lighter mallets are used for fine, de-

tailed work. Rasps and rifflers, as well as the other tools, may be rough on the hands. A pair of gloves, therefore, will be most useful. Gloves with leather palms are recommended.

Proper care of one's tools is most important and will eventually pay a great dividend. All tools should be cleaned immediately after they have been used. Most of them can be wiped clean with a soft cloth. Rasps, files, and rifflers can be cleaned with steel brushes. It cannot be overstressed that carving tools, if they are to be effective, must be kept sharp at all times.

Procedures

It is best to approach woodcarving by first discussing with the students the qualities of wood. To be informed of its cutting characteristics, grain, and its response to sanding, waxing, staining, and polychroming can be a great advantage to the students. Each student should then select a piece of wood for carving. As we have previously mentioned, the beginner would do well to choose a soft wood. He should study the block diligently, attempting to determine what image it can best yield. There are those who advocate modeling the image in clay, but such an indirect approach to formulating an idea is considered undersirable. It is best that the idea come from the block from which it will be carved or, if the idea has been preconceived, to find a piece of wood appropriate to its form. In the first approach the beginner would be more likely to relate his idea to the shape of the wood mass, deriving compactness and avoiding projecting forms which inevitably result in complex carving and substantial undercutting. Images carved directly from the block that has suggested the idea usually result in sculpture of great vitality.

With the idea well fixed in the mind and after having experienced the preliminary use of tools, the beginner draws simple, rough sketches of his idea on the four sides of the block, being careful to align them exactly. These sketches are usually conceived in terms of mass and form, utilizing as much of the block as possible. The purpose of these drawings is merely to serve as guidelines and to help the sculptor to visualize the image as he works.

The student can now begin the actual carving. The initial experience is one of doubt, uncertainty, and trepidation. It is best to begin by slowly removing the large unwanted areas with a chisel or gouge,

whichever seems most suitable. An attempt to remove an entire area at one time is not recommended. It merely adds to the disintegration of the composition. The comprehensive idea of the image should be the sculptor's preliminary concern. He should carve around the entire block taking a little away at a time, developing the whole simultaneously and studying the image carefully as he carves. As he roughs out the image, carving away at the drawings, he should stop as the need arises to redraw the guidelines before proceeding, then, to carve toward the more refined image.

It is highly recommended that the student be encouraged to turn his block or, in the case of an extra heavy piece, to walk around it constantly while carving, pausing to study and ponder each successive move; that he be reminded again and again to refrain from concerning himself with details and refinement until after the entire image has been successfully roughed out; that he be taught to chip the wood away at an angle rather than to cut toward the center of the block; and that he be informed to cut with the grain of the wood as much as possible

"Head" (soft pine) by a high school student. *Courtesy George Benedict, West Genesee High School, Camillus, New York.*

in order to facilitate carving. Wood, unlike plaster or stone, has a grain that must be respected. To cut against the grain is difficult and likely to cause the wood to splinter and tear.

Once the rough image has been blocked out, the sculptor begins the more detailed carving with smaller, flat chisels and shallow gouges. He may also use rasps and eventually rifflers and sandpaper. The rasps should be fitted with wooden handles to protect the hands. Handles are inexpensive and can be purchased as a separate item. Unlike those on chisels and gouges, they are detachable. A few good handles can thus serve a number of rasps. It is important that each individual be permitted and encouraged to experiment and to discover his best, most suitable, and natural method of carving wood.

As the carving approaches the final stages of completion, the use of the larger mallets gives way to the use of smaller, lighter mallets, which also are eventually discarded. The piece is finished almost completely with small chisels and gouges that are used with pressure

"Three Heads" (laminated blocks of wood) by a high school student. *Courtesy Dolores E. Onuscheck, Bethlehem Joint School, Pennsylvania.*

applied by the hand alone. Rare woods are more attractive if the cutting-tool marks are left on the surface, but most of the inexpensive softwoods used by beginners profit usually from a sandpaper finish and a protective coating of shellac and wax.

No matter how well the wood is seasoned, it will invariably have some small cracks or checks. The checks may be remedied by filling them with paste made from fine sawdust of the same wood and a plastic glue. It is practically impossible to prevent wood from checking and cracking, but the danger can be minimized. It is imperative, however, that the pores of the wood be sealed to prevent the penetration of moisture. This can be done to a degree with an application of wax or by giving the entire piece of wood a coat of shellac.

Wood sculpture that is located in an area of fluctuating temperatures and inconsistent moisture conditions will continually expand and contract. Under such circumstances it is wise to fill all cracks with a beeswax. When the wood contracts, the wax will be forced out of the cracks and can be scraped off, leaving the surface smooth and unblemished. Unlike inert fillers, wax permits the wood to breathe. Beeswax can be heated and easily mixed with oil paints to match the natural color of the wood. It is impossible to fill an extra large crack except with a wedge and wood paste, but if it does not interfere with the design of the sculpture, the crack need not be disturbing or thought of as a detraction from the piece.

Wood can be chemically treated so that under most circumstances it will not be affected by moisture or change in temperature. The process is one of impregnating the wood with a resin chemical that reacts with the wood cellulose, altering its physical properties. Unfortunately, such specially prepared wood is expensive and difficult to obtain. Perhaps the best the beginner can hope for is to secure well-seasoned wood.

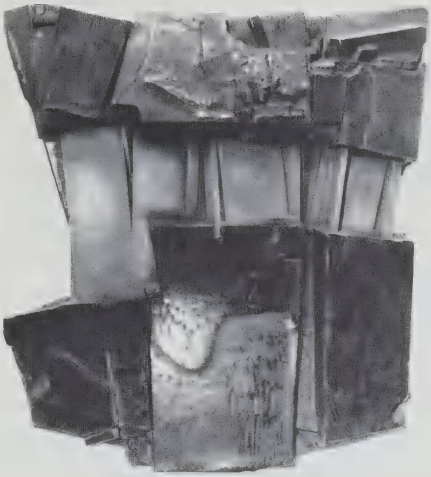
Finishing the sculpture

There are many different ways of finishing a piece of wood sculpture. The finish, however, should be determined by the nature of the idea that the sculptor wishes to depict. For example, the piece may be roughly carved with the tool marks left to contribute to an idea of conflict, anguish, or its rugged character. It would not seem proper to eliminate the very texture that can help bring it into being. On the other hand, if the idea calls for a simple, graceful depiction, the piece may be smoothly finished and highly polished. In the latter case, it would

"The Prophet" (walnut) by Laurence Schmeckebier, Syracuse University. *Courtesy of the artist.* "Tired Bard" (wood) by Ivan Mestrovic *(Syracuse University Collection).*

be a necessity to sand carefully, to eliminate the impaired or marred areas, and to seek for a degree of perfection. If one desires, and if the nature of the idea so dictates, the piece may even be polychromed. But whatever the finish, it should be kept in mind that the completion of a piece of wood sculpture must be performed with consideration for both the design and the inherent qualities of the wood.

Most woods are so naturally beautiful that it seems almost sacrilegious to give them any kind of coating. Unfortunately, woods used by beginning sculptors are soft, porous, and very light in color, and for the most part result in small works of art that are most likely to be handled considerably. For these as well as for aesthetic reasons they are, therefore, more apt to profit from some sort of stain and/or protective coating.



"Hoboken No. 13" (polyurethane and wood) by Roger Bolomey, New York. Photographed by John A. Ferrari. *Courtesy of the artist (private collection).* "Man Drawing a Sword" (wood) by Ernst Barlach. *Courtesy of Galleries —Cranbrook Academy of Art, Bloomfield Hills, Michigan.*

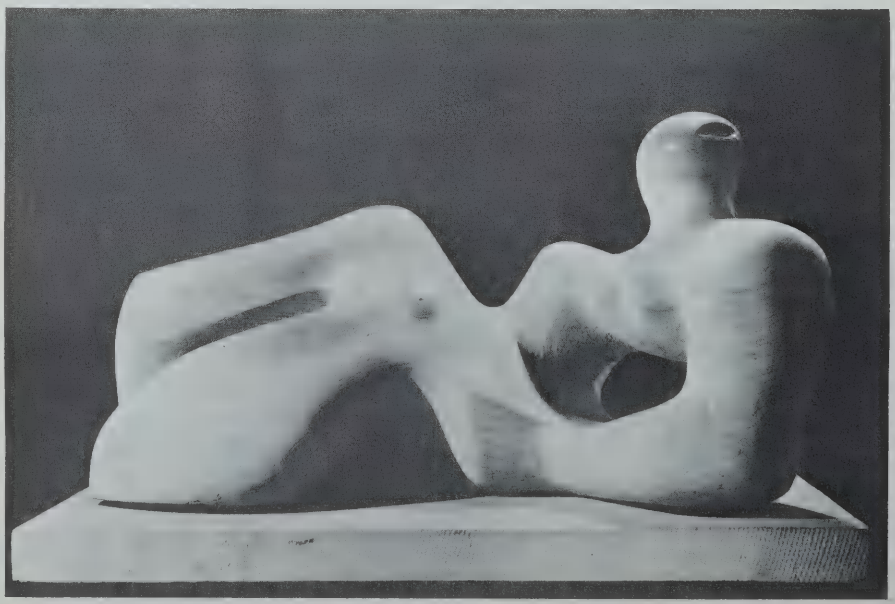
The quickest and easiest way to apply a protective coating is to use a clear-plastic fixative which can be purchased in cans with compressed propellants. The plastic spray protects the sculpture against moisture and smudging. It should be applied in several thin coats. Each successive coat should be applied only after the preceding has had a chance to dry. Brushing on a fixative is more time consuming but it is undoubtedly a much more effective method. One may make his own fixative by mixing a lacquer and lacquer thinner or rectified turpentine, or a clear shellac and alcohol. The ratio of lacquer to thinner or shellac to alcohol is determined by the degree of gloss or dullness desired. The more lacquer or shellac, the greater the degree of gloss. A solution of half and half, or 75 per cent lacquer to 25 per cent thinner (or shellac to alcohol) is recommended. The solution should be applied with a good, clean brush. Care should be taken not to dab on or scrub in the lacquer or shellac solutions. The brushes can be cleaned by using the appropriate substance present—either the thinner, the turpentine, or the alcohol.

Chaim Gross recommends using a finish of two parts of white shellac to one part of alcohol, well mixed with a few drops of olive oil. By a few drops, Gross means ten to fifteen drops to each ounce of alcohol.[3] When the protective coating is thoroughly dry it should be rubbed lightly with very fine steel wool to smooth out the fixative, removing any burrs that might have resulted from the protective solution. Care should be taken not to rub hard enough to cut through the protective coating. Several coats should be applied to the softer, more porous woods and especially to those that show signs of checking and cracking.

Frequently the sculptor wishes to heighten the beauty of the wood by bringing out the grain. This can be done effectively with the use of stains, linseed oil, or transparent oil paints that have been thinned with turpentine. The colored wood stains are applied, left standing for a few minutes, and wiped clean with a soft cloth. The longer the stain is allowed to stand, the darker will be its effect. It is advisable for those who are not familiar with the effects of stains on wood to try using it first on scraps of the same kind of wood. Oil stains, if used properly,

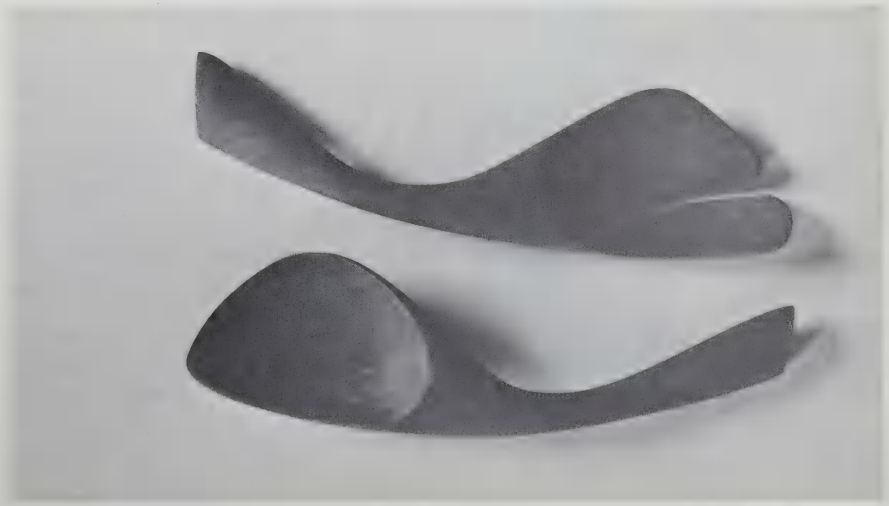
3 Chaim Gross, *The Techniques of Wood Sculpture* (New York: Vista House Publishers, 1957), p. 85.

"Reclining Figure" (wood) by Henry Moore. *Courtesy Albright-Knox Art Gallery, Buffalo, New York.*



can enhance most light-colored woods. Boiled linseed oil, which is fairly inexpensive, is usually applied freely with a soft cloth and allowed to soak into the wood as much as possible. The excess oil is wiped off to prevent a tacky thickness on the surface. Linseed oil has a tendency to give a beautiful luster, especially to walnut, cherry, and mahogany, but unfortunately does not seal the pores of the wood against moisture. A good oil solution for use on wood sculpture can be made by mixing one ounce of vinegar with one ounce of olive oil in a quart of warm water. A coat of household wax may be applied to cover, protect, and give the wood a gloss or polished finish. It is applied with a cloth and briskly polished. If an extremely high polish is desired, successive coats are applied and polished vigorously until this effect is obtained. The final polish is best done with a piece of flannel or any comparably soft cloth.

The harder, more exotic woods such as ebony, lignum vitae, rosewood, and teak bear a wax content. Unlike the soft woods, they do not require a protective coating. It is best simply to sand them smoothly and to rub them briskly with a brush or cloth. The same may be said of cherry and walnut, but since they do not bear their own wax a slight application of household wax would be in order. Many sculptors use an agate burnisher to polish the surface of hardwoods. Burnishing presses down the fibers of wood, giving it a durable surface and a brilliant polish. It is done not only to pieces that have been sanded, but also to those that reveal the chiseled tool marks. If an agate burnisher is not available, the student may rub the sculpture down with a small piece of the identical hardwood.



Although the wood sculpture of today is rarely colored, there was a time in history when most of it was. The ancient Egyptians, Greeks, Chinese, and Japanese, as well as the Renaissance carvers, produced large amounts of colored sculpture. Most of it, unfortunately, was colored in an attempt either to camouflage the abhorrent qualities of the wood being used or to accent authentically such features of the subject as the eyes, lips, hair, and skin.

Most modern sculptors believe that the application of color to sculpture tends to nullify the inherent beauty of the wood. Some of them do not care to take the time to perfect its use, and others are more concerned with the quality of volume and form and have no special interest in color. Still others have found that color can be used

Applied sculpture gives aesthetic form to three-dimensional objects designed to serve man's practical needs. The products reproduced on these two pages call for a sculptural process logically aligned with carving.

to give emphasis and to control pattern. Many of them, in fact, have discovered that the discreet use of color can add to the esthetic qualities of a piece of sculpture.

When planning to polychrome wood sculpture, one should first apply an undercoating of gesso, made of whiting and glue. If the gesso is to be merely an undercoating, it may be applied as a thin layer. However, if it is to be incorporated into the surface design, it is best applied as a thick layer and modeled slightly before it hardens. It is then painted over with oil paints. The surface may be cut into, exposing the gesso and/or wood underneath, and producing a sgraffito or incised decorative effect.

Gold, aluminum, or varicolored leaf is frequently used on wood and, at times, on ceramic sculpture for its fluorescent effects. The leaf

is applied to the wood with a quick-drying adhesive. One should use leaf sparingly and with great care so that the sculpture is enhanced and complimented. After the adhesive has had a chance to dry, one should brush away the loose leaf briskly so that what remains is irregular rather than in solid sheets. The leaf, which is then painted over, acts as an undercoating, gleaming through the paint, adding a delicate metallic strength, and producing an attractive surface.

Carved Relief Sculpture

So much of art today is thought of and conceived in two dimensions that when one attempts to teach sculpture the student finds it a difficult medium. For this reason, many educators have come to believe that, since relief sculpture is much like picture making, perhaps it is not as difficult to execute as sculpture in-the-round and, therefore, should be the introduction.

Although relief sculpture may not be as difficult as sculpture in-the-round, it is certainly as difficult, if not more so, to perfect. Implicit in relief sculpture is the compositional arrangement of forms in the horizontal-vertical plane of two-dimensional art; but, in addition—to however slight a degree—relief sculpture considers the integration of its spatial dimensions. This, at first glance, may seem obvious; but the difference in what is understood and what is here implied has frequently led to a modified attempt to carve high relief figures superimposed on a flat background, with very little or no consideration for the aesthetic relationship of the three dimensions.

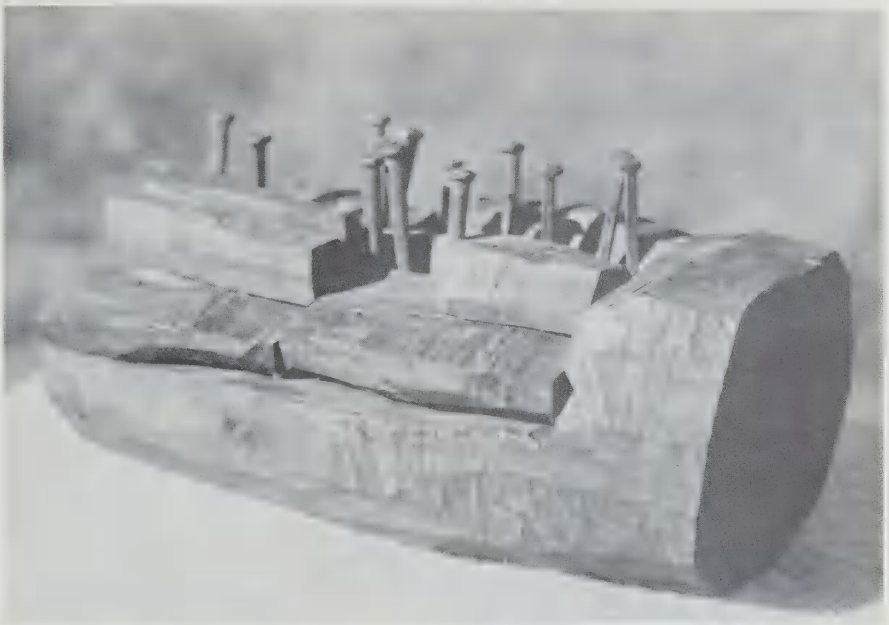
The nature of this relationship may be seen in the sculpture of Lorenzo Ghiberti and Ivan Mestrovic. Their relief carvings, which are among the best, reflect different interpretations of space. Unlike Ghiberti, who employed an array of vistas with images transcending several of them and establishing an integrative relationship in space, Mestrovic carved in two, low relief, clearly defined planes. Mestrovic's images do not move from one vista or plane into another, receding into or advancing from the background, but are carved in low relief, moving laterally left and right.

Mestrovic's procedure is the better of the two for beginning wood carvers. It is recommended that one first make a simplified outline drawing on paper the size of the board to be carved and then transfer it to the wood. An alternate method would be to draw directly on the

surface of the wood. Although preliminary drawings are frequently frowned upon by the more experienced carver, they are most helpful to beginners. After the drawing has been completed, a straight scoreline is cut around the forms. These incised lines can best be made with either the V-shape or parting tool. The student then proceeds to remove carefully the background with a gouge, cutting with the grain of the wood as much as possible.

To prevent cutting away more than one desires, a guard-cut is made at the outer edge of the image which, in reality, is the scoreline or the outline of the image. To make a guard-cut, merely cut deeper into the

"Quintet Playing Violins" (relief in wood) by Ivan Mestrovic *(Syracuse University Collection)*.



"Reclining Log I" (walnut and spikes) by Raymond Musselwhite, North Carolina State, Raleigh, North Carolina. *Courtesy of the artist.*

scoreline, repeating the process and preparing for each successive stroke until the desired depth is obtained. Removing the background is tedious and requires skill and great patience. Care must be taken not to cut too deeply into the background. A recession of no more than one-eighth to one-quarter of an inch will result in an attractive relief.

The kind of tool used is dependent upon the cut to be made. After the block has been scored and the desired depth determined, a half-round gouge is likely to be the best tool for crudely roughing out the design. As the work progresses, more shallow and smaller gouges are employed. As the carver removes the background he simultaneously defines the image, being careful not to allow himself to become concerned with working prematurely on the details. No one part of the sculpture, background, or image should be carried through to completion before the other. All phases of the sculpture should be kept going so that it evolves at one time as a whole.

The chisels and gouges are driven into the wood with the aid of a mallet, especially at the beginning. As the carving approaches com-

"Figure of a Seated Chief in the 'Fumani' Posture" (stone), Angola, Mboma Tribe. Photographed by Eliot Elisofon. *Courtesy of Mr. and Mrs. Harold Rome, New York.*

pletion, the cutting tools can best be controlled without the mallet. Pressure is supplied and directed by the hands as the tools shave and plane the surface, defining the image. Rasps, rifflers, and, finally, sandpaper are used to refine and give the relief sculpture meaning. For the most part, rasps may be reserved for sculpture in-the-round, but rifflers and sandpaper can be most useful in relief carving. In using either rifflers or sandpaper, one should take care not to bear down too hard, destroying the surface undulations and sensitive meaning of the sculpture. Relief sculpture can be finished in any of the processes described on the preceding pages under "Finishing the sculpture."

Sculpture in Stone

Carving in stone is much like carving in wood. It is, however, a much slower, more tedious and arduous art, demanding more patience, determination, and perseverance. To many it represents the peak experience in sculpture.

The primary difference in stone and wood carving is inherent in the properties of the media. Stone is hard, durable, and inflexible and therefore time consuming. Much of the time is actually consumed in purely mechanical labor. This has a tendency to encourage impatience, shortcuts, and the use of power tools, which so frequently are detrimental to the aesthetic quality of the sculpture. The qualities of stone—its mass, volume, hardness, durability, inertness, and solidity—call for a broad, simple, and more compact treatment of design. It commands a unity not to be found in wood or the additive media. Its natural qualities contribute to the idea to be carved. If one studies the stone, it will suggest treatment compatible with the carver's idea.

The principle of carving stone is quite simple. It is the same as for wood and the softer media such as plaster and soap. It consists of cutting away the superfluous material, leaving a mass symbolic of the sculptor's expression. It is wise to keep in mind constantly that the finished form should acknowledge the character of the stone. Its resistance naturally requires greater physical strength and energy and, for this reason, usually results in greater satisfaction than does the carving of other materials.

Beginners too frequently have a tendency to carve forms relative to their visual impressions of nature. The results do not incorporate the characteristics of the medium but instead merely represent the appear-

ances of life and, as such, unfortunately cannot be considered good art.

Working in a hard material such as stone requires a subordination of the storytelling approach or realistic treatment. Therefore, it is advisable that anyone required to work in stone possess a thorough knowledge of the principle involving the relationship of idea to material. Certain ideas—subject matter—are more appropriate to the solid, massive quality of stone than others. Some are, in fact, more appropriate or suitable to the softer stones while others are better adapted to granite or diorite. Unlike painting, sculptural ideas must be expressed in appropriate materials.

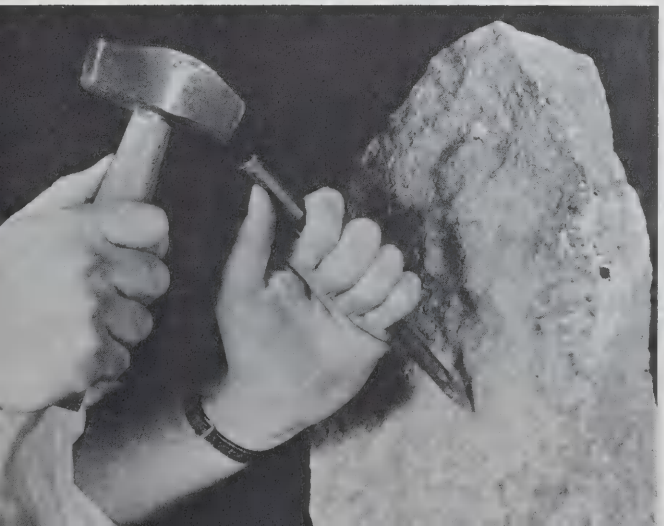
Preliminary experiences in carving help the student become familiar with the possibilities of the medium. The beginner should acknowledge that he is a student involved in the learning process; he should be encouraged, therefore, to explore, experiment, and discover the material and to be not overly concerned with the production of a good piece of sculpture. This will come soon enough, and much sooner if the learning attitude is adopted.

If the beginner avails himself of the opportunity to experiment, unconcerned with preconceived notions and traditional ideas, he will discover the properties of the medium and a vast range of possibilities in relating his ideas and needs to the materials. He will be much better able to obtain maximum effects from the characteristics of stone and to shape it into forms that are appropriate to its sculptural properties. In the process, his ability to sculpture creatively will be developing. Good sculpture is an expression wherein the idea harmonizes with the material.

There are instructors who recommend that beginners prepare small studies in clay or wax before carving the block of stone. These preliminary sketches are to help the students work out problems of form in some workable medium before attacking the massive stone. Others advise the use of a block of clay the shape of the stone to be cut. The soft clay is cut away and modeled into the form the student intends to carve in stone. Although such artists as Michelangelo, Cellini, and da Vinci used and advocated the use of such models, there are those who do not recommend such preliminary steps. They contend that the plastic consistency of the clay subordinates one's impressions to its inherent qualities and thus encourages one to model detail while ignoring the character of stone. Though the professional sculptor, cognizant of such facts, permits modifications as the carving progresses—taking into

consideration and respecting the demands of the stone—the less-experienced artist is more likely to end up, if he is successful, with a stone carving that unfortunately resembles the characteristics of a plastic medium. Plastic media are submissive, and since beginners have a tendency to conceive ideas relative to life forms, the results are usually protruding forms and fragile details unrelated to the properties of the material in which the ideas are finally to be carved. Many of the works of Michelangelo depict such character, but the carvers of today must keep in mind that we live at another time and that our concepts of stone carving are quite different. There is today a greater regard for a harmonious collaboration between ideas and the properties of the materials used. Students should be encouraged to contemplate the materials and to attempt to integrate thought and material into a work of art.

Many sculptors such as De Creeft, Mestrovic, Brancusi, Warneke, Zorach, and Hord prefer to and contend that one should work directly in stone, putting one's enthusiasm and inspiration into the carving rather than into the preliminary sketches. They contend that direct carving results in a great vitality and spontaneity that is often lacking in transferring ideas from one medium to another. A true carving is best conceived directly in its final substance. Since carving materials vary from the softness of plaster to the hardness of granite, even plaster studies as guides for stone carving are frowned upon. It is much better to work in the final material from the inception of one's ideas to the completion of the sculpture. Working directly in stone



encourages a subordination of true-to-life forms to those resulting from the properties of stone. Since the qualities of stone vary, the appearance of the completed piece of sculpture will vary, but in most cases a good stone carving today will possess the characteristic of solidity, mass, compactness, volume, and the natural proportions of the original block. The direct carving process forces the student to consider his idea in terms of large, simple, mass forms. It is here that the instructor can be of great help. He can encourage the student to think of simple basic shapes at the beginning, reserving the final stages until after he has defined his idea in terms of its relationship to the medium. A concern for the harmonious relationship between idea and material may well encourage the student to deviate from a narrative, painterly approach to a more sculptural process.

If the student feels more comfortable in using preliminary sketches, he should be encouraged to make a number of rough sketches. Under no circumstances, however, should they be considered final or allowed to crystallize the student's vision of his basic idea. The student should not force the stone to fit his sketches, but should feel free to change and alter his plans as he carves. The ultimate creation takes place in the carving of the stone itself.

Complexities of carving have caused some art educators to advocate that the beginner first carve solely for the technical experience, becoming familiar with the properties of the stone and the characteristics of the tools. They suggest that in the process the student attempt to relate harmoniously nonobjective forms without any express purpose other than that of creating pure design. As an exercise this is quite conceivable, but great sculpture is much more than the mere juxtaposition of shapes.

Others have advocated that, since relief carving is closer to drawing and therefore much easier to comprehend and possibly to execute than sculpture in-the-round, it would be wise to begin with relief sculpture. The idea has some merit. Young artists, much like the primitive artist, are prone to think in terms of frontality. To conceive of a piece of sculpture in three dimensions is definitely more difficult. To carve from a block of stone producing what would literally be four reliefs, however, should be acceptable, providing some consideration for unity is attempted. Actually, very few works of sculpture escape the laws of frontality. Most of it is created to be seen *en face* or *en profil.*

Characteristics of stone

Stone is a sculptural material which dates back to antiquity. The tools and methods of carving are today much like those of the past. In fact, even with the advent of technology there is very little change in stone carving from its very beginning. Although there are hundreds of different materials that are used in sculpturing, stone as a material remains the staunch symbol of *sculpture*. It is relatively inexpensive and can be found readily in most parts of the world. Stones are available in a great variety of colors, textures, and durability. They vary from the softer varieties of sedimentary formations to the hard, compact, igneous stones. The size and composition of the grain or crystals determine its texture and durability. One can avail himself of stones that are dull, opaque, semitranslucent, or translucent. They range in color from pure milky white toward pinks and blues to jet black. Some stones are mottled, striped, and veined; others are uniformly colored throughout.

Unlike wood, which is usually carved in the direction of its grain, stones can be cut in all directions. In fact, it is best to carve evenly from all sides—the only exception being stones of pronounced scale or cleaves. In such cases it is advisable to carve in one direction.

The stones used more commonly by beginners include caen, soapstone, limestone, sandstone, and alabaster. More experienced carvers usually prefer marbles, granite, and other related igneous rocks. The following list presents descriptions of the more generally used stones. They are listed alphabetically rather than in any preferential order.

Alabaster is a soft hydrous sulphate of limestone considered by carvers as one of the easiest to carve. It can be obtained in colors of white and various tints of yellow and red, and comes in various degrees of translucence and opaqueness. It is often mistaken for marble.

Basalt is a hard, fine-grained stone of igneous origin which is capable of taking a high polish. It is a fairly compact stone of columnar structure and is almost as difficult to carve as granite. The tools required are, in fact, identical to those used to transform granite into sculptured forms. Basalt can be found in the northwestern part of the United States, principally in the states of Idaho, Oregon, and Washington.

Boulders and Large Pebbles are hard, rounded stones of igneous origin that have been removed from their original bed by natural agents such as floods and glaciers. They can be found in all parts of the world. Boulders usually are of conglomerate composition.

The more common ingredients are quartz, feldspar, mica, and silica. The softer limestone and sandstone varieties disintegrate in time, but those that are primarily composed of granite are worn smooth by nature, taking on interesting shapes suggestive of sculptural forms that need little attenuation to turn them into beautiful works of art. The boulder is a popular stone for such sculptors as John Flannagan, William Zorach, and John Di Spirito.

Granite is a hard, compact, coarse-grained stone, far too difficult for anyone but the professional carver to consider. One does not carve granite, but literally wears it away by crushing and pulverizing the granite crystals with the aid of thick, blunt-pointed, hard, tempered steel chisels and heavy hammers. It may seem strange, but some granites are capable of a very high polish. Granite is found mostly in the eastern states. Vermont produces, possibly, the largest amount of granite used in the United States. Maine, Massachusetts, Missouri, New Hampshire, North Carolina, Pennsylvania, Rhode Island, and Texas also quarry large quantities of granite. Pennsylvania produces a jet black variety, and Missouri produces an attractive dark red granite.

Limestone is a sedimentary stone formed from the intermingled particles of stone deposited in bodies of water and the calcareous skeletal remains of shellfish and small animals that have been subjected to chemical changes, extreme pressure, and heat over a long period of time. Limestone is one of the best soft stones for beginning carvers. It is generally softer than marble and is more readily available and much less expensive. The stones are generally gray or buff in color, easier to carve than most stones, and will finish into a very smooth luster. Unlike marble, limestones will not take on a high polish. The most popular, Indian limestone, can be secured in either gray or buff and is a surprisingly attractive stone. Other highly acceptable varieties of limestone may be found in Alabama, Arkansas, Kentucky, Minnesota, Missouri, Texas, and Wisconsin. The Alabama variety of limestone is slightly harder than the others. Anyone wanting a white limestone may best consider Minnesota limestone.

Marble is the sculptor's first choice. It is softer than igneous stones and more durable than limestone or sandstone. It is a fine, close-grained, compact stone capable of taking a high glossy finish. The pure calcite or dolomite varieties range from pure white to a jet black depending upon the impurities contained, which may be evenly distributed throughout the stone or may be found in spots or streaks. Alabama, California, Colorado, Illinois, Indiana, Tennessee, and Vermont produce virtually all the marble in the United States. Bel-

gium, France, Greece, and Italy are noted for the foreign varieties. Belgium is best known for its "Black Belgium," a fairly compact, durable but fragile marble. France produces many mottled, veined, and striped varieties. These are a little more difficult to cut than white marble. Greece has perhaps the finest marble for sculpturing in the world. Italy is famed for its snow-white, fine-grained Carrara marble. Carrara was used extensively by Michelangelo Buonarroti. Marble may also be found in Africa, Asia, Canada, and South America.

"Virgin Mary" (Georgia marble) by the author *(private collection)*.

Georgia marble is a difficult stone to carve. The large crystals easily flake off, distorting the sculptor's image. The author overcame this difficulty by broadening the bridge of the nose and reducing the distance of its protrusion. The face is highly polished by pumice powder and the hair is textured by a bushhammer.

Sandstone is a porous, compact, fairly durable stone of sedimentary origin. It is composed of fine grains of silica pressed together with a cementing or binding agent such as earth clay, calcite, or iron oxide in various degrees. Sandstone ranges from a fragile to a very hard and difficult-to-carve variety. It can be found in gray, yellow, blue, buff, red, brown, green, and black colors. Pure calcareous and siliceous varieties range from pure white to pale yellow. The iron oxide binder is responsible for the red, brown, and buff colors. Sandstone can be found almost anywhere in the United States. The leading producers are Connecticut, Kentucky, Ohio, Pennsylvania, and Wisconsin. Sandstone is also quarried in Canada, England, and France. It is used extensively for building constructions.

Slate is a fragile stone made up of laminated layers of flintlike siliceous material. It comes in sheets rather than block form, and is therefore most conducive to bas relief carving. Its fragility requires that it be shaped with small rasps, files, rifflers, and abrasive stones and powders. If chisels are used, it is recommended that they be hand driven rather than struck with a hammer. Slate usually comes in black, but it can be obtained in various values of gray, green, and red. It is quarried largely in the northeastern part of the United States. Maine, New York, and Pennsylvania are the leading producers. However, large deposits are also found in Maryland and Virginia.

Obsidian is a hard, brittle, vitreous rock that results from volcanic action. It is usually dark gray or black in color and can be found predominantly in Italy, Mexico, and Peru. Some obsidian can be found in the western part of the United States. It is a delicate stone that cannot be carved with chisels. The shaping is done mostly with rasps, files, rifflers, and abrasives. It can be polished to a brilliant, glasslike finish.

Miscellaneous Stones such as jade, diabase, diorite, porphyry, travertine, onyx, quartz, and gypsum may also be used for carving. Diabase and diorite are granites and, like most granites, very hard and difficult to carve. Porphyry, a volcanic rock, as well as jade, onyx, travertine, gypsum, and the different forms of quartz are either not readily available, too costly, or, for one reason or another, extremely difficult to carve and are thus recommended only with great reservation.

Tools and equipment

The tools and equipment used today for carving stone are remarkably similar in principle to those used by the primitives. Technology has given us a greater variety of tools, better metals, and mechanized

and electrical power, to be sure; but the basic principle of creative carving remains the same. The sculptor has a tremendous desire to incorporate his feelings and thoughts into stone by relating them to the innate properties and characteristics of the medium. The technical procedure for achieving this desired end is basically one of cutting and wearing away the material, establishing essential forms expressive of the initial idea. The tools needed to perform such an act have always been the same, that is, something with which to cut, crush, maul, pulverize, abrade, and polish. Mechanical developments, if not properly utilized, can be a detriment rather than an advantage.

The basic tools for stone carving consist of chisels, hammers, and files. These tools are, of course, different from the chisels, hammers, and files used for wood carving. For the beginner who will be carving soft stone, the blunt-point and tooth chisels are essential. Flat and drill chisels may also be considered basic tools. The blunt-point chisels are used at the beginning to remove large masses of stone. As the work progresses, the blunt-point chisels are replaced by the more delicate and sharper points. The tooth chisel is used fundamentally to rough out the incipient forms of the sculptor's idea. They are used to cut grooves into the surface of the stone which are in turn removed by cutting perpendicular to the first grooves or furrows with the tooth chisel. Tooth chisels have an advantage over the point chisels in that they are able to cut a wider area across the surface of the stone. They are also less likely to dig too deeply into the stone. The flat chisel, much like the tooth chisel, is used at an oblique angle to the surface of the stone. It is capable of removing a larger area of the surface at one

time than the points. The flat chisel is used principally as a surface finishing tool. Drill chisels have a more specific use than do the other tools mentioned. Their primary function is to make holes and to cut into hard-to-get-to places.

Metal mallets, or hammers, as they are more frequently called, are usually two to four pounds in weight. They are used to furnish the power to drive the chisels into the stone. More professional sculptors, especially those working on enormous pieces of stone, frequently use pneumatic equipment to furnish the power and thus minimize the expenditure of physical energy. On more delicate, soft stones and during the finishing stages the use of pneumatic hammers would be devastating. At this stage of carving, wooden mallets are more frequently used. They do not produce as violent a vibration as do the pneumatic or larger metal hammers.

The bushhammer is an indispensable tool. It is essentially a hammer with a pounding head approximately one inch square, which is divided into equally spaced rows of pyramidal teeth. The number of teeth will vary with the size of the bushhammer, but the average

"Stone Sculpture" by high school students. *Courtesy Richard DeAngelo, North Syracuse High School, North Syracuse, New York.*

number of teeth is usually between nine and sixteen. The bushhammer is used to pulverize the surface, lightly removing thin layers of the stone successively and literally roughing out and refining the forms. The bushhammer leaves a pitted texture which, if not desired, can be removed with the aid of a flat chisel and abrasive stones.

Bush chisels, patterned after bushhammers, are useful for delicate and hard-to-get-to areas. The bush chisel is held and used much like any other chisel; it is struck with a mallet or light hammer. Bush chisels, and bushhammers as well, should be cleaned constantly so that they may be more effectively used and also as a precaution against fracturing the teeth.

Abrasive tools are used in the final stages of stone sculpture. There are rasps, files, and rifflers. Rasps are used to remove the deeper tool marks made by the chisels and to help shape the stone.

"Atelier," Montrouge, 1962. Alicia Penalba's studio in Paris, France, where many delicate pieces of stone sculpture are carved. *Courtesy Galeria Bonino, Ltd., New York.*

"Woman" (limestone), first carving by an adult amateur sculptor.

Files and rifflers, which are actually small rasps, are used to refine the surface even further. When using abrasive tools one should remember not to bear down or force the tool, but instead to let it slide lightly across the surface. The tool is usually pushed with the right hand, with a slight side-to-side rotation of the wrist, and guided with the left hand.

There are other abrasive aids not classified as tools but which, nevertheless, are very useful in smoothing and polishing stone sculpture. Stones—especially carborundum and pumice—are used as abrasives to cut, smooth, and polish. Powders such as emery, corundum, and silicon carbide are used as abrasives in finishing and polishing stone surfaces.

Protective goggles and gloves are considered indispensable equipment for stone carving. Goggles protect the eyes from flying pieces of stone and dust, especially during the roughing-out stages. Gloves, much like those recommended for wood carving, will protect the hands against blistering and injury from the rough stone surface. A respirator mask to prevent the inhalation of stone dust may be a consideration if a lot of stone carving is done, but since most students do very little, the mask may be considered more a hindrance than an aid.

To hold the smaller pieces of stone in place while carving, many sculptors use a barrel filled with sand. The process is described in the section on tools and equipment under "Sculpture in Wood." Some

carvers usually plaster the smaller stones to larger ones in an effort to hold them firm while carving. A strong and very solid bench made of four by fours and two-inch planks may be used for medium-sized stones. Pieces of two by four may be nailed flatly alongside the stone to keep it from rolling. The larger pieces of stone that are heavy enough to anchor themselves to the floor need no support.

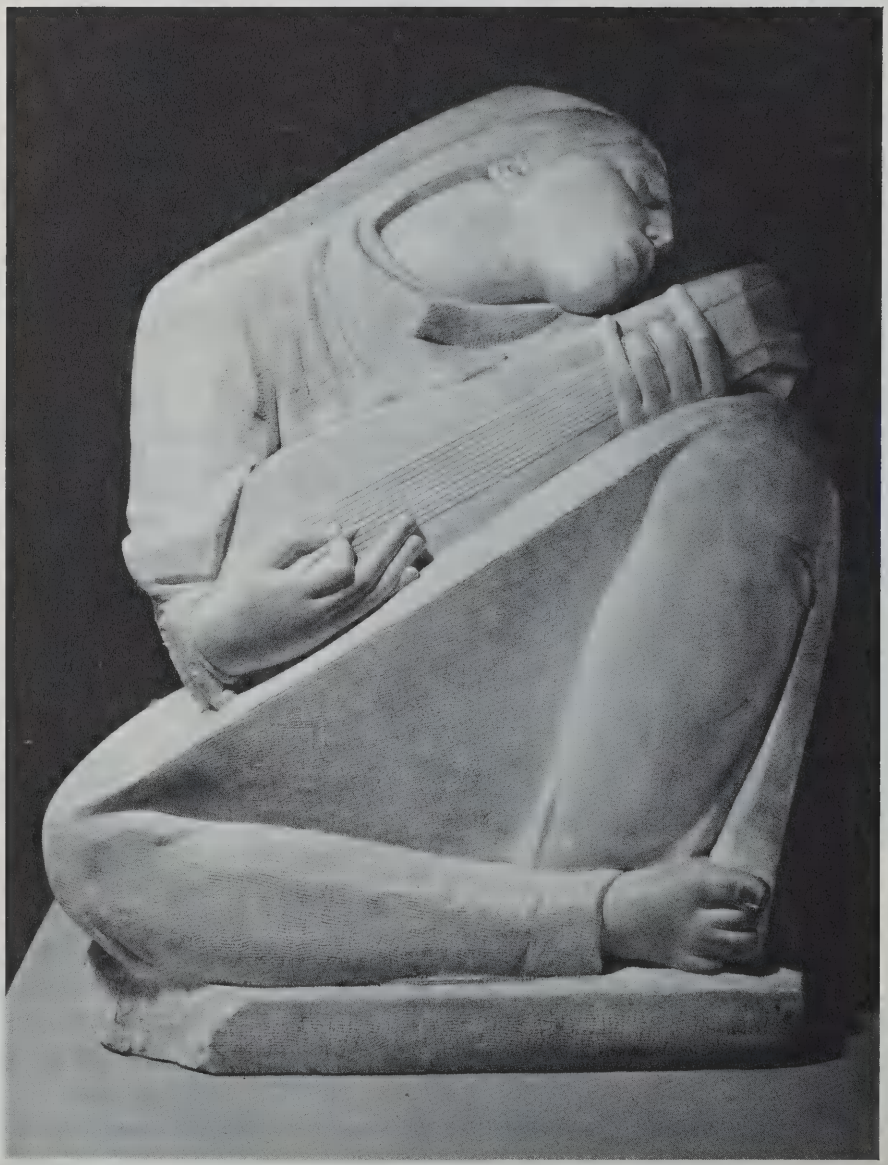
Anyone who works a great deal with stone should be familiar with the methods of tempering and sharpening his own tools. It is most important for a student to keep his carving tools sharp at all times, and a knowledge of how to sharpen tools will save money and valuable time. Fortunately, stone-carving tools can be sharpened easily with nothing more than water and a simple carborundum wheel.

"Bird" (marble textured with a bushhammer) by a college student, Syracuse University.

Procedure

There are actually two principal methods of carving stone: the direct and the indirect. The indirect employs images that have been modeled in a plastic substance, cast in a more durable material such as plaster of Paris and, finally, with the aid of a pointing machine, duplicated in stone. This approach is a purely reproductive method and of little value to the educational process.

"Croatian Rhapsody" (stone) by Ivan Mestrovic *(Syracuse University Collection)*.



The direct method, on the other hand, is essentially a creative process. One may prepare preliminary sketches in clay or wax as previously discussed but the final carving is done directly in stone. Whether one chooses to use or not to use the preliminary sketches does not alter the fact that this method of carving is far from being a mechanistic process and, therefore, is likely to result in carvings that are more spontaneous and dynamic.

The technique of direct carving is quite simple. It is not unlike that used by prehistoric man. The first step is to secure a solid block of stone. For the beginner it is wise to choose a soft stone such as caen, sandstone, or limestone. A stone can be tested by sounding it with a tap of the hammer. If it sounds dull, it is probably cracked inside; but if it has a clear ring, it is solid and safe enough to carve. The shape of the stone is then studied for possible carving ideas. The ideas should be compatible with the shape of the stone. After the idea is determined, drawings of the image are made on the four sides of the stone with chalk or opaque water-base paint. Since stone has the characteristics of solidity, mass, and volume, it is expedient to respect these qualities. The general forms are blocked out much in the same manner as outlined in the procedure for carving wood. The outer mass of stone is removed with the point chisels until the roughing out is completed.

There are no set rules in carving. Each individual must discover for himself the best procedure. There are, however, some procedures that are recommended by experienced carvers as being most appropriate; these will be discussed from time to time throughout this part of the book. It is recommended in carving, for example, that the point chisel be held at approximately a forty-five-degree angle to the surface of the stone in order to prevent fracturing the stone, breaking the point of the chisel, or having the chisel become affixed to the stone. Cut the grooves or furrows in one direction and then remove the ridges by cutting crosswise. At this stage one may alternate between point chisel and bushhammer, being careful not to overdo the bushhammering.

As in wood carving, most beginners are so anxious to develop the image that they begin too soon to work the details. This can be detrimental to the aesthetic outcome of the finished piece. It is best to work

"Madonna and Child" (diorite) by Ivan Mestrovic *(Syracuse University Collection)*.

slowly, concentrating and deliberating on the larger general forms before becoming concerned with the finer features.

The final development of the general forms is done with tooth and flat chisels and large rasps. To carve large general forms primarily in related masses and to refine carefully these forms on the basis of the abstract principles of art, however, are not enough. Unless, at this stage, the sculptural character of the stone (color, texture, durability, grain, volume, degree of solidity, and durability) is developed in compatible collaboration with the sculptor's idea, the sculpture as a work of art is doomed to failure. It may be perfect in its technical execution but lack true aesthetic form. The intensity of the idea has been discussed in the introduction. It need be cited again and again, however, lest it be forgotten. A piece of sculpture will be good to the degree that the sculptor's idea, his encounter with his world, fulfills his own being and is translated into the idioms of the materials used.

If the sculptor is truly expressing a unique encounter with his own world he will of necessity carefully and deliberately carve all around the stone, developing all sides simultaneously, constantly combining the idea, the medium with all its dispositions, and his talent into something we can call art. He may be reminded to turn his stone constantly while carving and to develop all sides slowly, deliberately, and simultaneously, taking away a little stone at a time and pausing to study each successive step. Unless he understands himself or has been taught to react to what he believes, his creative ability will be atrophied and no amount of objectified intellectual assistance will lead to the creation of art.

Finishing stone sculpture

Following the rough and refined stages of stone carving come the final stages of completing the sculpture. It must be remembered, however, that the idea must be a vital consideration in the finishing process. Some ideas call for a more complex refinement process than others. If the idea calls for simple, broad forms and a textured surface, a coarse stone such as limestone, sandstone, and possibly granite may be considered. The stone is carved in a simplified design and finished with rasps, files, and the bushhammer. If a more refined finish is desired, the rifflers and abrasive stones may be used.

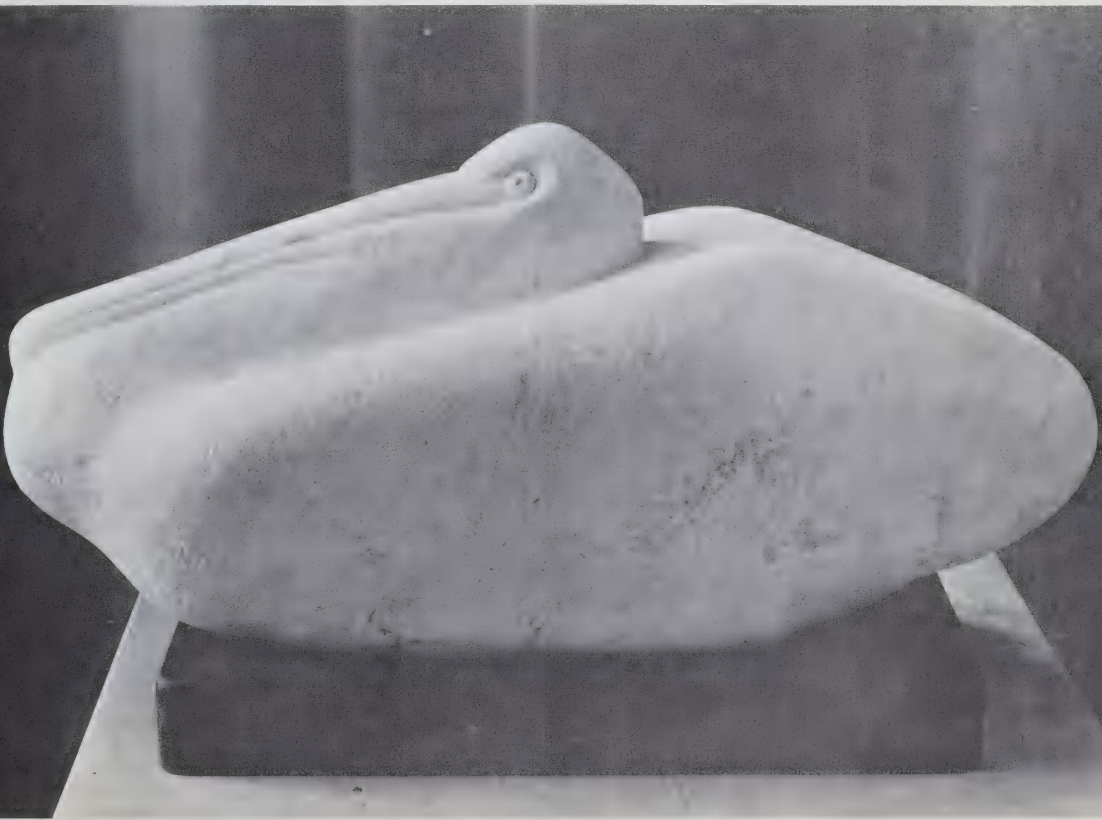
On the other hand, if the idea calls for a greater degree of detail and/or a smooth polished surface, the sculptor may well choose a marble. After the initial use of rifflers and coarse abrasive stones, one of the fine abrasive stones, a hone, or even a hard piece of wood may be employed. For a high polish, abrasive powders such as emery, alumina, or tin oxide and a cloth or piece of felt are used. The stone is drenched with water, sprinkled with a fine abrasive powder, and rubbed gently and evenly with a circular motion to bring out the richness of the natural texture and the color of the stone. Polishing stone, although not difficult, is tedious, time consuming and requires great perserverance. After the final abrasive polishing, the stone is washed with clear water and dried with a soft cloth. If one desires, a coat of clear wax may be rubbed into the surface to bring out the brilliant luster and to protect the stone from becoming stained and dirty.

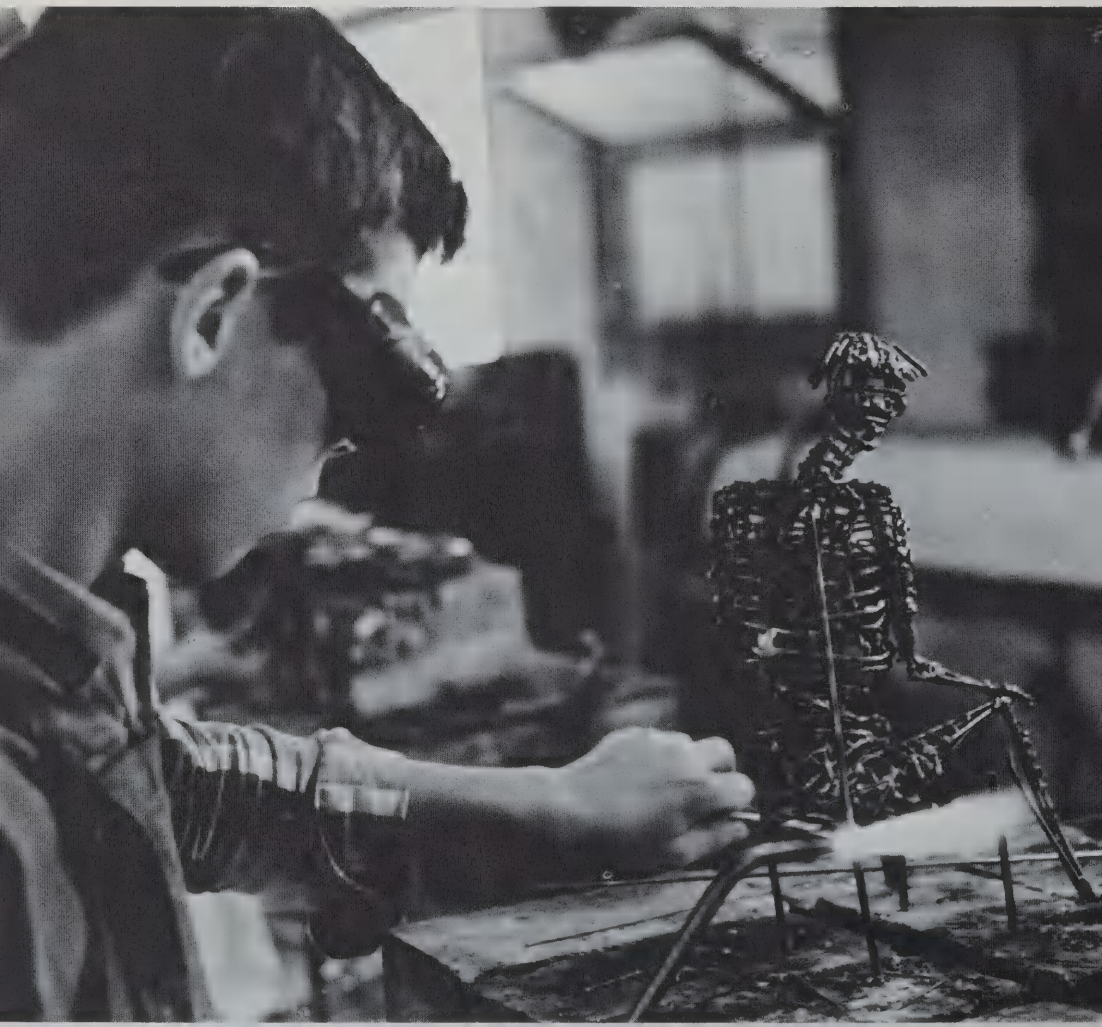
Sculpture usually appeals to the spectator's sense of touch. It will therefore eventually become dirty. To clean stone sculpture, all one needs is water, a stiff brush, and a commercial cleanser. One may even use whiting or fine marble dust. If the stone acquires a hard-to-remove stain, a fine abrasive powder or a weak solution of oxalic acid may be used to remove the discoloration. Once the stain is removed, the stone should be washed immediately with clear water to rinse away all traces of the abrasive material or acid.

Coloring stone sculpture

Very few students today are taught to use color in creating sculpture, in spite of the fact that from antiquity to the seventeenth century very few stone images were created without some touch of color. There are a few sculptors today who are experimenting with the possibilities of rubbing colored powders into the surface of the stone to color certain portions of the sculpture, but the process is not encouraged to any degree. Color, if used with discretion, can add to the accomplishment of transferring thoughts and feelings into tangible forms. It should always be regarded as an important element of expression and never as a cover for a medium considered abhorrent in its nakedness. The fact remains, however, that the work of inexperienced carvers gains more from being left without color than from being colored.

"White Pelican" (Vermont marble) by the author *(private collection)*.



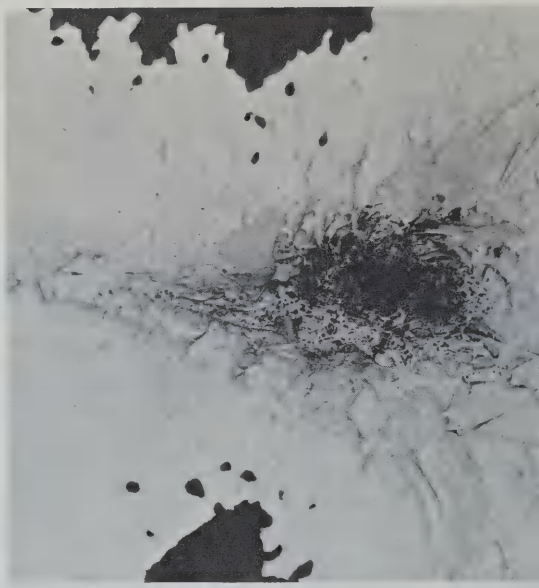


PART
THREE

Constructing

At one time sculpture was thought of as a process with two major divisions, modeling and carving. Today, however, we find it necessary to add a third category, that of constructing. Although there are many professional sculptors and art critics who are unwilling to recognize these volume designs as bona fide forms of sculpture, they have withstood the tests that make them worthy of equal esteem with modeled sculpture and carvings.

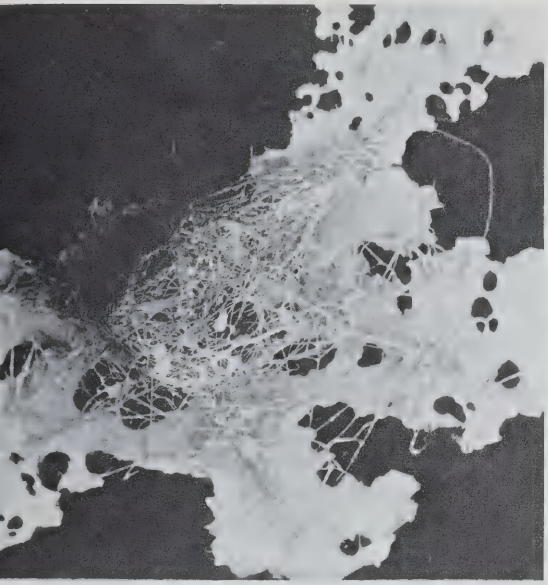
Constructivism is the newest and most fascinating addition to the field of sculpture. It differs from the tradi-

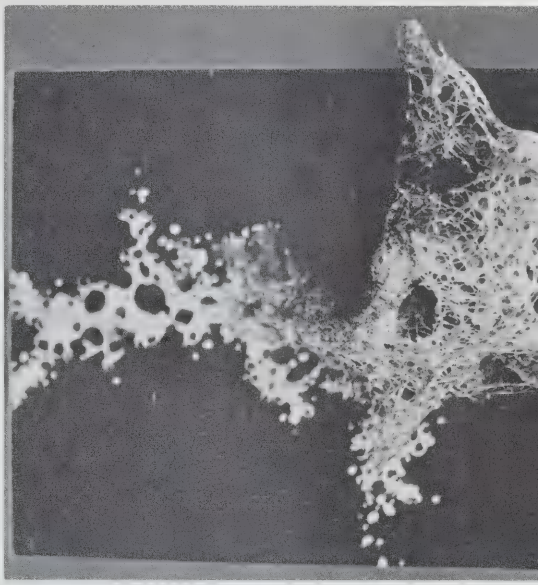


tional processes of modeling and carving in that its primary consideration is defining space and motion by using the structural elements through which space can best be defined and movement obtained. Constructivism represents an advanced stage of sculptural development. Its principal objective is to move from illusionistic into literal space, to produce a work of art that exists in time and space.

The sculptor, as a constructivist, is no longer interested in being involved with the interpretation of mass-volume, static rhythms, solidity, expression of personal emotions, and the illusion of reality. He is preoccupied with problems of shaping his materials to proclaim his beliefs and reveal his notions in much the same manner as the scientist. There is definitely a close affinity between the contemporary physicist and the constructivist. Both are modifying our concepts of space, time, and motion. In our age of technical development and discovery, new meanings and ideas are being revealed.

Although the impetus for this new movement in art is frequently attributed to the founders of constructivism—Naum Gabo and Antoine Pesvner—its true origin lies in man's own tendency and willingness to perceive space. Artists have for years attempted to foster this natural tendency and nurture man's sensitivity to space by provoking slight, as



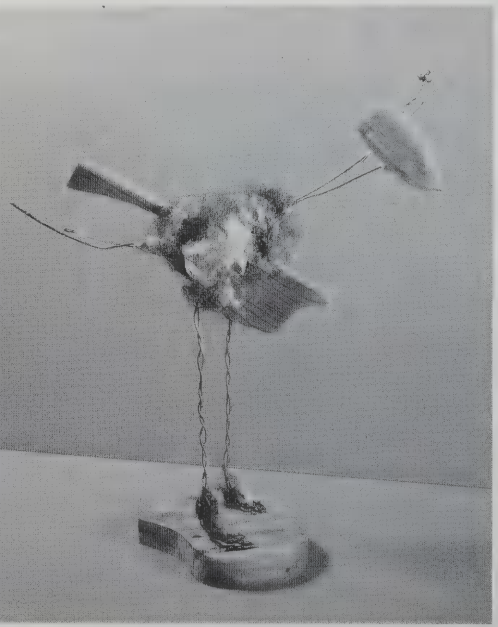


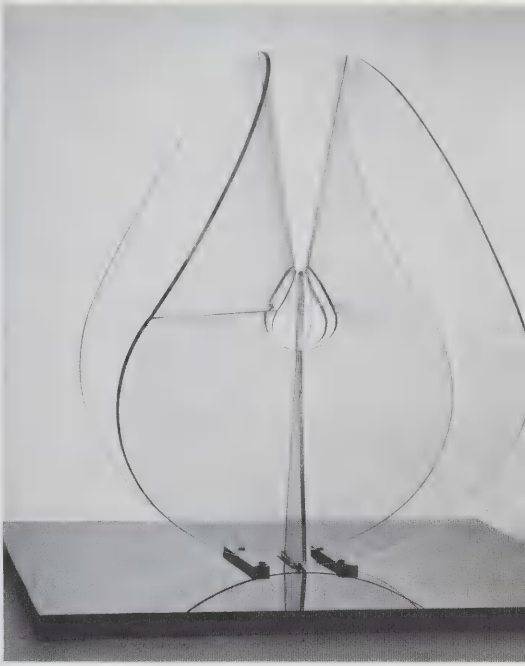
well as pronounced, impressions of depth. Painters such as Giotto di Bondone, Tommaso Masaccio, Benozzo Gossoli, Leonardo da Vinci, Andrea Mantegna, Jacopo Bellini, and Rembrandt van Rijn created the illusion of space through the use of receding planes, contrasts of light and dark, overlapping of shapes, and the impression of distance through perspective and relationship of sizes. Sculptors like Lorenzo Ghiberti, Filippo Brunnelleshi, Michelangelo Buonarroti, and Auguste Rodin learned by observing the sculpture of the ancient Egyptians, with its laws of frontality, that the creation of tangible, three-dimensional objects was not enough to suggest space; but by animating the figures and having them suggest actions, opening up, and liberating massive form, they were capable of creating sculpture that not only occupied and suggested space but actually began to define it.

There is no denying the historic role played by those that followed the Cubists, Futurists, and Dadaists in the evolution of constructivism. They have transformed iconography into abstract and nonobjective images; discovered various spatial qualities that emphasize time and space, while refuting mass by reducing it to a minimum; and aroused an incentive to explore and experiment with many unconventional materials. But, at most, all that the past was able to accomplish was to

depict the illusion of space. In an attempt to make space tangible and measurable, Braque, Miro, and Picasso experimented with wallpaper, theatre tickets, and a variety of textural material, creative reliefs that were neither paintings nor sculpture. This symbiotic combination of painting and pasting was the beginning of an art with three-dimensional tendencies, which freed it from the bounds of illusionism. The French called the technique collage, which literally means to paste up. Picasso carried the collage technique one step further by incorporating solid, three-dimensional objects. It was then only a matter of time before the artists began to design structures in space and the constructivist movement, as we know it, emerged into full bloom.

Constructivism is said to have originated in Moscow and further developed at the Bauhaus School of Art in Weimar and Dessau, Germany. It was the impact of the Bauhaus, with its experimental approach to new materials, that introduced constructivism to art education. Men like Josef Albers, Johannes Itten, Lazlo Moholy-Nagy, Walter Gropius, and Gyorgy Kepes did more than any other group to influence the principles of Bauhaus education and to bring constructivism to America.





"Construction Number 87" (stainless steel) by Jose De Rivera *(Collection Dr. Gilbert Stork)*. Photographed by O. E. Nelson. *Courtesy Grace Borgenicht Gallery, Inc.* "Translucent Variation on Spheric Theme," 1951 version of 1937 original (plastic) by Naum Gabo. *Courtesy of The Solomon R. Guggenheim Museum, New York City.*

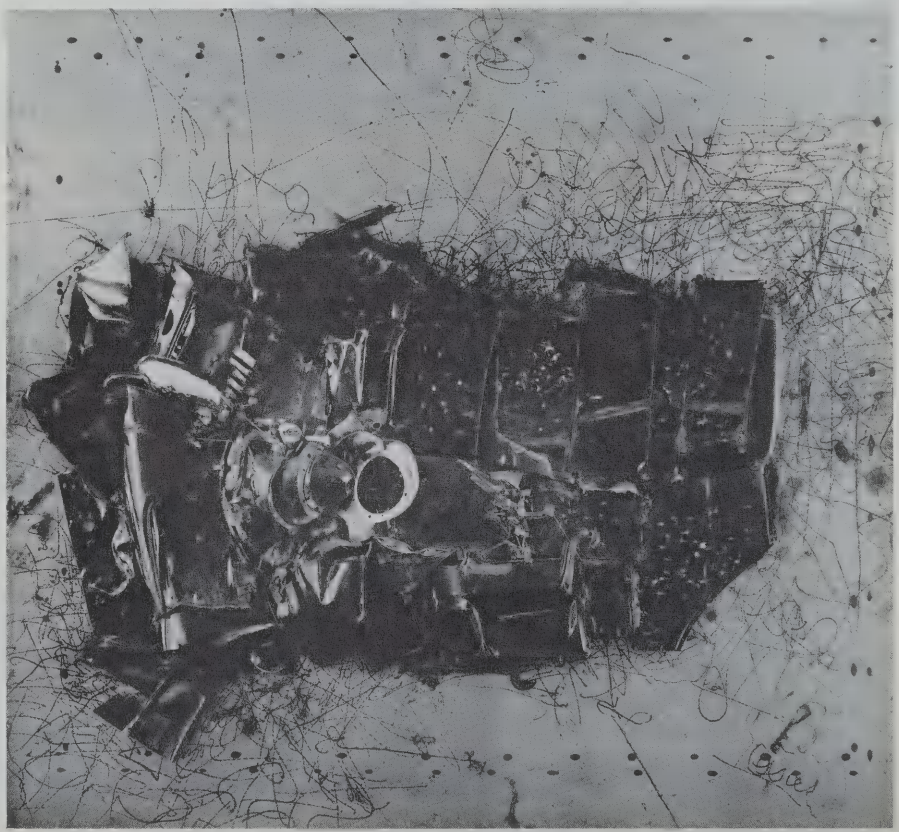
The true conquerors of space, however, were such sculptors as Naum Gabo, Antoine Pevsner, Alexander Rodchendo, Raymond Duchamp-Villon, Vladimir Tatlin, Alexander Calder, Kurt Schwitters, Umberto Boccioni, and Georges Vantongerloo. Calder, Duchamp-Villon, and Boccioni proclaimed the sovereign virtue of movement; Vantongerloo skillfully utilized the space around his solid forms as a positive element; Gabo and Pevsner eliminated the feeling of solidity and weight; Tatlin, Schwitters, and Rodchenko, depending upon a mathematical principle, attempted to sublimate and disintegrate mass.

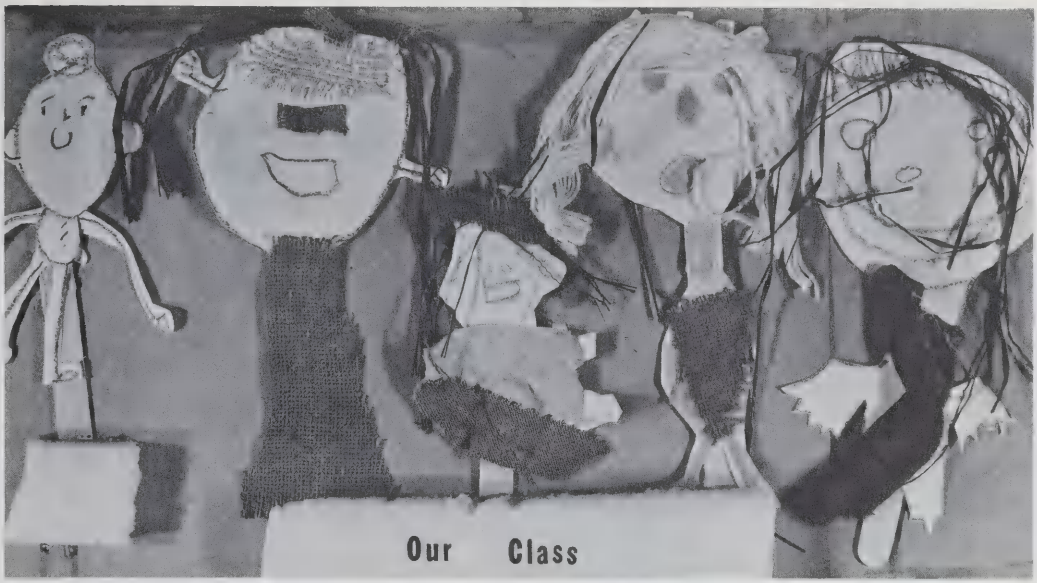
There are many distinctive characteristics of constructivism, but only the basic ones will be discussed here. Such techniques will include: *collage,* a sculpto-painting [1] concept in which the artist assembles an

[1] A term given to the technique by Alexander Archipenko.

array of textural materials on a flat surface and at times applies pigments; *stabile,* a three-dimensional construction made up of a variety of materials such as glass, metal, wire, and wood into a space-form relationship; *mobile,* a construction that can actually be put into motion by air currents or more mechanical means; *vibratile,* a structure so designed that when it is caused to vibrate it emits sound; *wire,* and *welded sculpture;* art forms in which space is a positive element defined by the linear quality of the material, and images are made of wire, steel, and other metals with the aid of a soldering tool and an oxy-acetylene torch.

"Facade Number I" by Cesar. Photographed by Luc Joubert. *Courtesy Galerie Claude Bernard, Paris, France.*





Collage

The art of collage has too often been defined as a process of pasting, gluing, and tacking textural materials to a flat surface for the purpose of creating a picture or an interesting pattern. Its objectives unfortunately have never been clearly spelled out. As a result, there has been an air of mystery and confusion, and a lack of significance and purpose. For example, a fifth-grade student who had been working on a "collage project" at school was asked by his mother, who was not acquainted with this new art form, "What is a collage?" to which he remarked, "Oh, you know. It's when you stick a lot of junk down on a big piece of paper." This remark, fortunately, does not characterize the practice in our schools, but one may well find the extreme opposite the rule. The educational approach, in most cases, has been one of merely teaching design principles with no real understanding of the collage concept. If we return to first principles for a moment we will discover that the greatest value of collage making lies in its presentation of a new concept of space-form relationship. The original collage is, in reality, a protest against pictorial sensuality on the one hand and flat abstract painting on the other.

Collage painting—relief (cloth, paint, and paste) by a college student, Syracuse University.

The collage is an outgrowth of the painter's interest in exploring space in front of the picture plane. His intent is to evolve a relief by utilizing the three-dimensional qualities of the materials. The collage came into being when serious artists like Picasso and Braque attempted to overcome the illusion of depth by using three-dimensional materials, and it became a transitional step toward constructions when Arp, Miro, and Nicholson began to create relief constructions of wood and metal. It served its purpose and, with the advent of stabile sculpture, passed on its way.

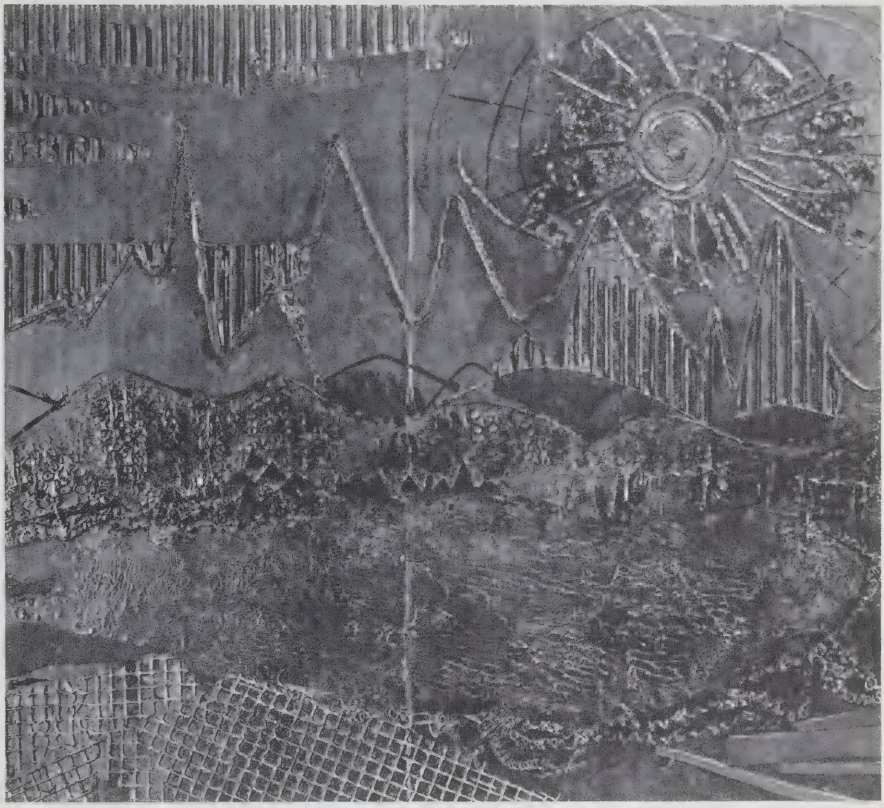
"Relief," 1934 (wood), by Hans Arp. *Courtesy The Miller Company, Meriden, Connecticut.*

We would, of course, be in great error to expect a similar dedication from children and inexperienced lay artists. There is, however, a variety of advantages in collage making, applicable to the various age levels from preschool children to professional artists.

For the very young it is a logical adventure comparable to the manipulation of paint and clay. To explore and experiment with an array of materials, developing a feeling for and an understanding of their properties and characteristics, is in essence a creative process. Children should be encouraged to use a variety of new materials so that they may experience the inherent dimensions of form, space, color, texture, volume, and motion and intensify their emotional reaction to them. The development of an awareness of the structural possibilities of materials is a prime goal. Only after they are fairly familiar with the medium should children attempt to utilize it in expression. Because the collage technique lends itself to a free and experimental approach with an infinite array of new materials, it tends to excite the imagination, to inspire invention, and to create personal concepts and standards of appreciation. It is most important that children be free to use the materials in their own way. The teacher must not give them exact directions, rather, he should merely indicate through discussion and suggestions how they may make their own choices and arrive at their own conclusions. The teacher, for example, may discuss with the children their reactions to certain tactile materials and the repetition of form; the relationship between different sizes, colors, shapes, and textures; and the various properties of materials.

Motivation should be centered around the nature of the materials and the first principles of collage making. Children may be permitted to create pictorial collages if they so desire, but they should by all means be encouraged to make collages that are abstract in nature and free of representation. If they are not preoccupied with problems that embody literary suggestions, they are more likely to evolve new concepts of reality. There is always a danger in pictorial collage that an interest in representation may obscure the real principles. Subject matter, because it tends to emphasize the illusion of reality, can distract from the issues of a collage. To allow picture making merely delays the proper orientation toward the objectives of collage making.

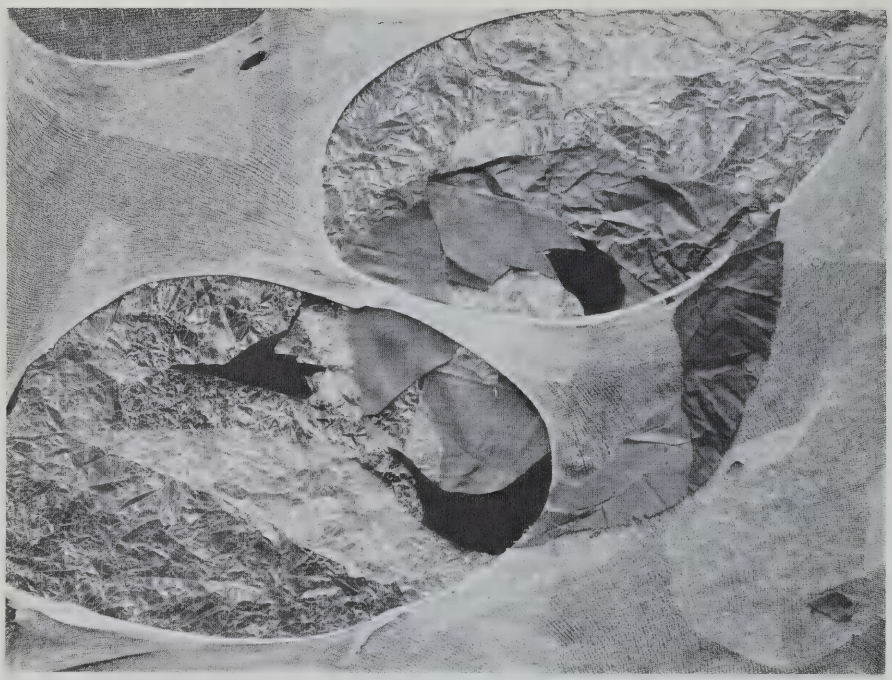
There are a number of preliminary exercises that may be used in an effort to develop an awareness of and sensitivity to spatial qualities.



Collage relief (corrugated cardboard, string, paste, screen wire, and broom straws) by a college student, Syracuse University.

Experiences with building blocks, the pasting of small cardboard boxes and other raised surfaces on a flat surface, as well as modeling in relief with either potter's clay or plasticine can aid in the development of a sensitivity to space.

The more mature students may well be encouraged to utilize and respond to materials that exhibit qualities of three-dimensionality. The character of the material should suggest being twisted, bent, and formed in space. If the student does not realize these possibilities for himself, the teacher should help him become aware of them.



For the high school student and amateur artist, collage making becomes largely an intellectual and sophisticated process. Adults are capable of using a more systematic approach, incorporating elements of design in an effort to achieve a degree of economy and simplicity and a greater quality of expression.

Characteristics of collage materials

The greatness of art is determined by the creative powers of the artist's mind. It reflects the profundity of his thoughts and feelings. In the past, medium was considered merely a means for giving visual form to these ideas; the nature of the material was considered irrelevant and insignificant. Today, however, with our new attitude to life, and our transformation from a sensual-sentimental individualist's approach to a more general intellectual interest in the universal principles of our environment, materials are becoming more than a means to giving outward form to emotional expressions. To the constructivist,

who is interested in the exploration of matter and space, they play a most important part in determining the form of his product. To him there is no dividing line between material and creation. Modern sculpture is an art form wherein ideas harmonize with the materials. There are no special collage materials; each objective dictates its own. Virtually all the various materials of the natural and technical worlds are collage materials. Our environment is our storage bin. There are the conventional classroom materials: construction paper, string, cellophane, and colored yarn. In addition, one can use cardboard boxes, reed, raffia, tongue depressors, sand paper, aluminum foil, glass, and cotton.

Since a collage results in part from our effort to use the intrinsic beauty of everyday materials, we should consider such materials of nature as tree bark, branches, seed pods, egg shells, and pine cones.

It is imperative, however, that the classroom teacher for whom collage making is fairly new be especially careful not to become a complacent victim of "canned" collage materials. Some of these canned or so-called special collage materials that have become hackneyed as a result of overuse and improper motivation and guidance are corrugated cardboard, cellophane, gingham prints, wallpaper, colored feathers, burlap, pipe cleaners, and felt. It is easy for a collage to become ambiguous and purely decorative when such threadbare materials are used. There must be a meaningful experience that has a profound influence on the student and to a great extent determines his sensitivity to the environment in which he lives. Children should be furnished with a variety of elements from which they can make personal selections, but there is greater value in having them seek and find their own materials. The experience of looking stimulates an awareness of texture, color, and pattern; helps one become sensitive to his environment; fosters the habit of searching and discovering; and tends to relate the materials used to the student's own environment and the immediate principle involved. Found materials can also be insignificant unless the teacher guides and strongly motivates the students to choose those that can be utilized for the sole purpose of exploiting collage principles. For the young student it may be the discovery of textural materials, natural objects, and aesthetic values. For the more mature student, materials may be chosen for their three-dimensional quality or for the purpose of expressing ideas or spatial and translucent effects.

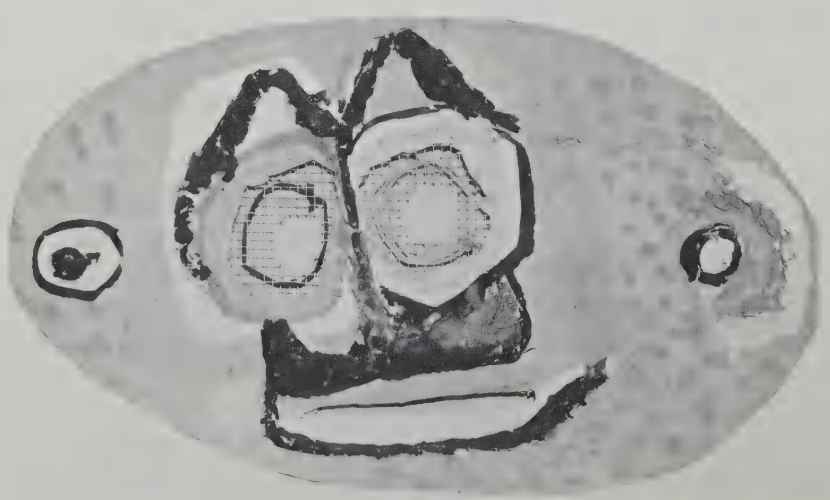
The experienced student who has a strong desire to acquire greater

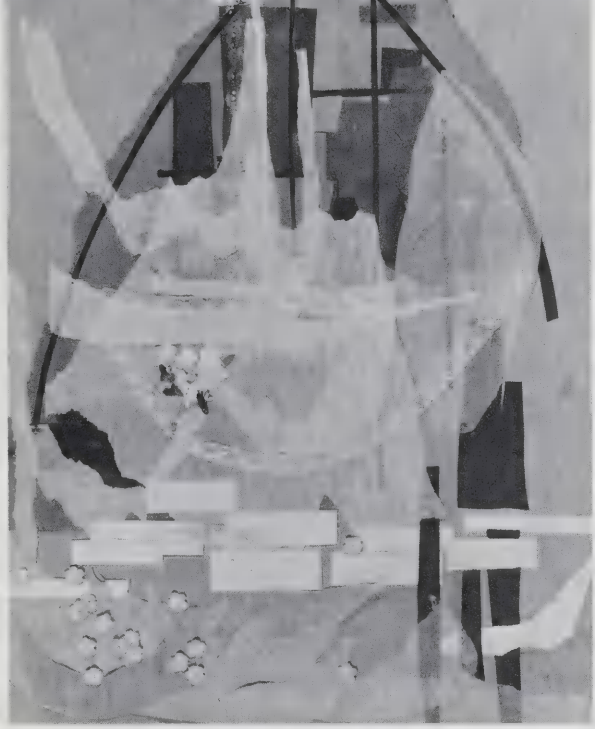
skills and proficiency in collage making may seek materials that embody movement, identify space and plastic relations, portray emotional symbols and architectonic structure, and convey the sublimation and disintegration of mass.

Tools and equipment

The tools and equipment needed are those used mainly to prepare and secure the materials to the background. They are not as significant as the materials since they are means rather than ends in the art of collage making. They should, therefore, be furnished by the teachers through the school budget. Since most of the materials used in a collage call for pasting, it would seem appropriate to have on hand a variety of adhesives, some of the more common ones being paste, glue, and rubber cement. In addition, it would be appropriate to have tacks and hammers, staplers, staple guns, screws and screwdrivers, wire, string, pins, solder and a soldering gun, paper fasteners, needle and thread, and masking and scotch tape.

Other appropriate tools should include scissors, knives, a paper cutter, punch, saws, drill, sander, hatchet, carving tools, and an oxy-acetylene torch. These are obviously used to cut the materials and, perhaps even more important, to shape them, identifying and emphasizing their character. In addition, it is important to have available paints and paint brushes, as well as a few storage bins.





"Wedding" (collage made of lace, beads, and a variation of papers) by a college student, Syracuse University.

Procedure

At the beginning, as we have previously mentioned, children should be given a few prepared materials that are pliable, easily manipulated, and require no alteration. They should be encouraged to explore and experiment with the materials, making selections and becoming sensitive to their inherent qualities, unhampered by preconceived notions.

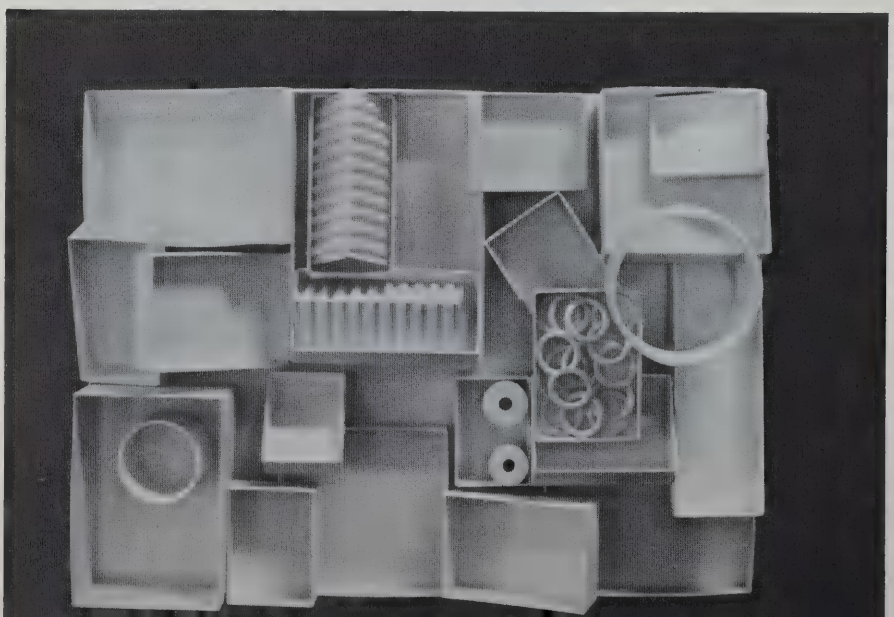
A watchful eye will indicate when the children have had their fill and when their interest in manipulating the materials for the purpose of becoming cognizant of their properties is on the wane. At this point, proper guidance will lead the children to the next logical step in development of collage making. They are encouraged to attempt to discover the relationships of colors, sizes, and textures, and to sense an interplay of the various properties and characteristics of the materials. The wise and alert teacher will guide the learner into new ways of seeing and thinking. At first it is advisable not to supply tools and adhesives. This will only tend to deter the students from exploring the material for its own sake, and from becoming sensitive to its characteristics. The quality of these manipulative experiences may seem to be of

little significance, but they undoubtedly have a profound influence on the learner, and to a great extent help to determine the quality of his later works of art.

This purely nonexpressive concept has to do with dimensions of experience. Search and discovery is a natural reality that has always existed and can be found at all age levels. These awarenesses are of intuitive origin; they exist in and of themselves. The images are discovered by the mind; they do not result from memory.

After the students experience the qualities of materials, they may be given the opportunity of acquainting themselves with cutting, tearing, pasting, and tacking. The older children may be offered a variety of experiences that are more inspiring and challenging. They may be given the opportunity of using a number of tools such as hammers, saws, drills, and tin snips in conjunction with wood, sheet metal, and wire. As the students gain understanding and the ability to sense the character of materials, they may be motivated to use the collage technique to express moods and ideas symbolically. We must keep in mind, however, that designing on a flat surface is of little value beyond the purpose of exploring art principles. A two-dimensional design is not a collage, in spite of its aesthetic values, for it negates the basic principles of plastic art.

Too frequently the students are left at the first stages of collage construction randomly and redundantly manipulating materials, even-



tually to become bored. With proper guidance they can be introduced to more complex constructions. Their approach to collage making should be a more conscious attempt to define the qualities of the materials and their relationship to space and to discover the true meaning and value of collage principles.

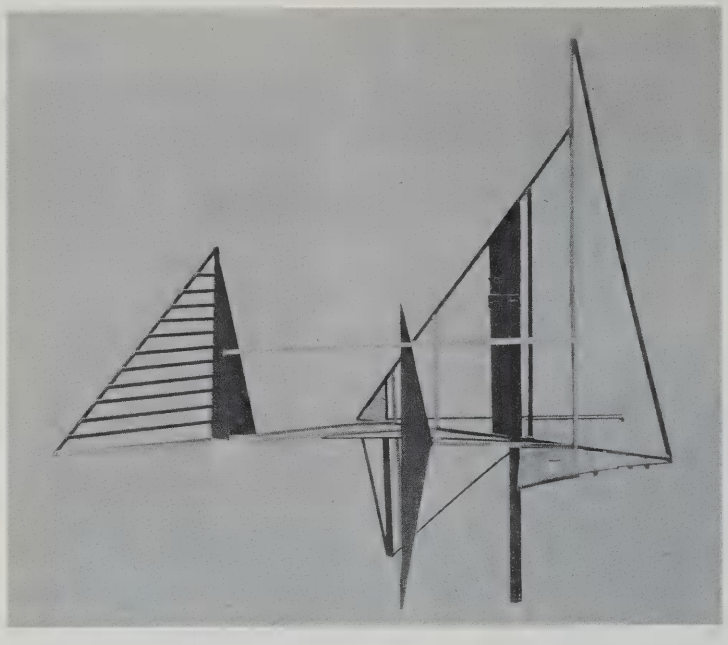
Stabiles [2]

As we trace the evolution of constructivism, we find that Cubist ideas continued to have a profound influence on the development of spatial art beyond the discovery of the collage. What was to have been a solution to the painter's problem with space merely intrigued the sculptors and encouraged them to experiment further. Since they were not especially pleased with the effects of the collage they began to create *montage* reliefs of paper, wood, plastics, metal, and other similar materials. These were, from the beginning, defined against a picture plane or background and were, in essence, a continuation of the breaking away from the illusion of space of the nineteenth century. Space, however, was still severely limited. In most cases the point of departure for such space sculpture was the surface of a wall or a prepared background.

In their attempt to define unlimited, endless, absolute space, the sculptors searched for a new three-dimensional vision—one that would truly define the relationship between volume and space. Their primary intention was to sculpture with space. They were not interested in iconography. Here was an opportunity for them to compose, utilizing form and space in terms other than depicting animal or human figures. It was an intellectual approach that excluded all subject matter and any explicit emotional expressions.

Each new age contributes a unique and distinct dimension to art. At the beginning of the twentieth century, shortly after World War I to be exact, the more adventurous sculptors became greatly involved with this space-form conception. Traces of subject matter had all but disappeared. Sculpture was being developed on the basis of abstract creations. This new sculptural tendency to design structures in space without any compromise with representationalism resulted in an art form called the stabile. When similar structures are put to motion they

[2] A term given to stationary abstract sculpture by Hans Arp.



Stabile (balsa wood) by a college student, University of Southern California.

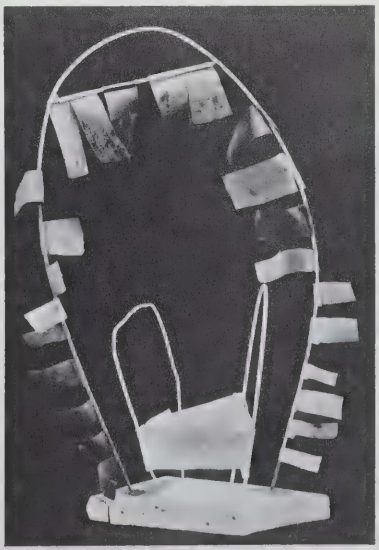
are classified as either vibratiles or mobiles. These will be discussed later in this section.

Before we discuss the materials and procedures relative to stabile construction, it is imperative that the teacher be aware of the importance of developing within the students an understanding of the basic principles of the stabile. It is also most important that he create an incentive for the exploration of these principles, for without understanding and interest, the making of a stabile is surely to result in failure. Fundamentally, stabiles are the result or by-product of three-dimensional studies in the relationship between volume and space. The objectives therefore are to explore the possibilities of defining space through the arrangements of volume-space; the use of interpenetrating geometrical forms; the disintegration of mass; the use of transparency and translucency; suggested movement; and the investigation of materials that contrast with space, enclose space, defy weightiness, affect light, and stress balance and rhythm. With this concept well established in our minds we are prepared to survey the availability of suitable materials.

Characteristics of stabile materials

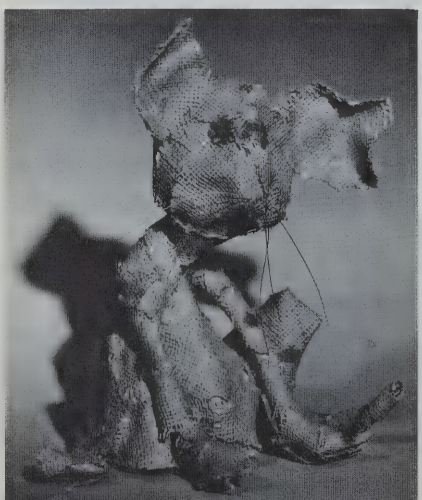
In the traditional sculptural processes a single medium is usually employed. In stabile construction, however, a number of different materials are used. Although the materials of stabile construction are not as varied and extensive as those used in making a collage, there are undoubtedly many provocative and inspiring materials available. In the selection, however, it is most important that the teacher keep in mind the first principles in stabile construction. Since the idea is to define space, it seems only natural that materials which lend themselves to space-form structures be considered. It is imperative also that this concern be passed on to those students who are instructed and encouraged to find some of their own materials. Since both volume and space are involved, the choice of materials is relatively unlimited. The emphasis, nevertheless, should be placed on those materials which lend themselves to the sublimation of mass into actual volumes.

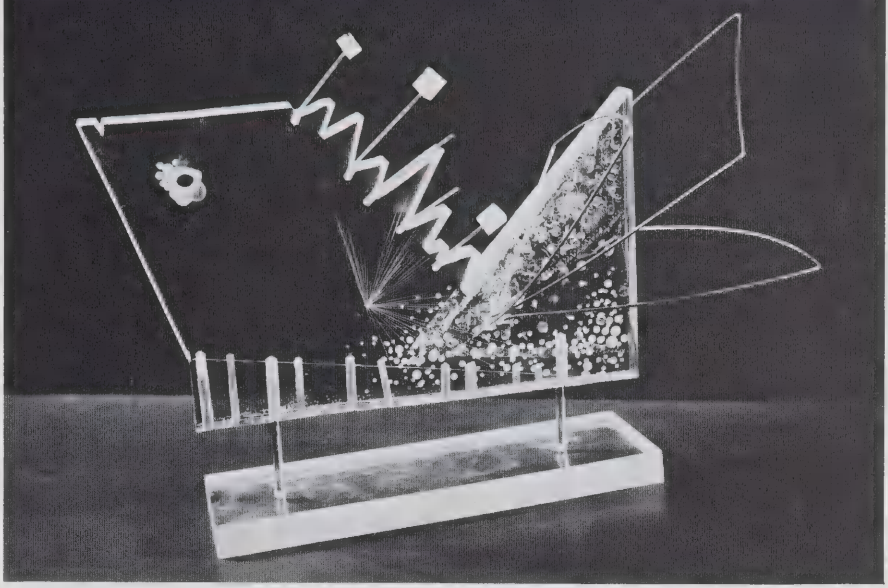
There are the basic materials that are furnished by the school. They include paper of all kinds: construction and textured paper, illustration board, oaktag, finger paper, and corrugated cardboard. It would also include hollow and solid building blocks of various sizes and shapes (cubes, discs, cylinders, wedges, arches, and brick forms), screen, felt, doweling, sheet cork, metal rods, glass, plastic, celluloid, reed, yarn, string, twine, and wire of assorted gauges.



As we have previously mentioned, unless the students are encouraged to help in providing materials they will not only be limited to what is available but will also be deprived of the values inherent in discovering new materials that are suitable for stabile construction and appropriate to their own ideas. The materials brought in by the students obviously will be determined by their availability in the students' immediate environment, the students' personal choice, and the intended use. Among these may be such materials as an array of cardboard boxes, which can easily be procurred from stores. The grocery store, for example, usually has a plentiful supply of large boxes, while drug stores and novelty shops have an assortment of smaller boxes. The students may also find cardboard tubes of different diameters and of various lengths, cloth, spools, aluminum foil, rope, burlap, sandpaper, and sheet metal. Among the more unorthodox and exotic materials that the student may find are marbles, jacks, ping pong and rubber balls, fabricated wood, twigs, branches, tree bark, electrician's wire, tarpaper and wooden shingles, and an assortment of nails, bolts, washers, insulation blocks, fire brick, fencing foils, bicycle chains, and wheel spokes.

Many of these materials, if properly used, will provide linear, volume, and transparent definitions. Others can be altered by cutting, bending, twisting, polishing, and perforating to suggest and enclose space, create movement and tension, defy and virtually eliminate the feeling of weight and solidity, modulate and modify space, and absorb, deflect, and reflect light. The more flexible materials such as cloth, string, twine, rope, copper wire, and screen can be interwoven, folded, cut, sewn, pasted, and turned into suggested forms.





Although the emphasis is primarily on the sublimation and disintegration of mass, the more tangible, solid materials are found to be useful. Georges Vantongerloo and Kasimar Malewitch used solid forms in their structures to bring out their mass relationships to one another in terms of the space that surrounded them. Wooden blocks, bricks, and cardboard boxes as ready-made forms are excellent to use in arranging combinations of mass form and expressing solidity, stability, monumental quality, and a feeling of permanence.

The stress on developing an understanding and appreciation of the inviolable right of materials was first initiated at the Bauhaus School of Art in Germany. Johannes Itten, one of its most promising instructors, was perhaps the greatest advocate of the idea of experimenting with materials. Others such as Arp, Picasso, Schwitters, Gabo, Pevsner, and Tatlin deliberately avoided all reference to living form, remained obedient to the three-dimensional tendencies of materials, and have contributed much to our modern version of stabile constructions. Black Mountain College, in North Carolina, under the direction of Albers, Moholy-Nagy's Institute of Design in Chicago, and the general field of industrial design are greatly responsible for Americanization of the Bauhaus principles. With the aid of such American-born sculptors as Ismau Naguchi, David Smith, Alexander Calder, Richard Lippold, and Seymour Lipton, the horizon of constructivism was widened and the art of stabile sculpture recognized, emphasized, and accepted in American schools.

Tools and equipment

The very nature of the materials used in stabile construction, as well as the concept of unprejudiced experimentation with materials, calls for a very large variety of small tools and equipment. Many of the tools used for stabile construction are similar to those used in creating collages. For the young child or beginner a variety of adhesives is needed, as well as scissors, pliers, hammers, staplers, screwdrivers, needles, and paper fasteners. The more experienced student, who may desire to explore the nature of a greater variety of materials, incorporating them into stabiles, will need an assortment of knives, saws, clamps, vices, chisels, casting equipment, carving and cutting tools, pliers and nippers, and rasps and files. He may also find a use for various power and electrical equipment such as a jig, bench, or hand saw, a sander, a solder gun, a spray gun, a metal and stone grinder, a welding arc, an oxyacetylene torch, and an enamel and ceramic kiln. The nature of the material and the intent of the sculptor would naturally indicate the type of tools and equipment needed. Many of these may be found in the other departments of the school. Others, of course, may not be available. The student, in fact, might be required to supply tools and equipment in order to meet his own personal needs.

The underlying dimensions of spatial design cannot be introduced too early in the child's life. This is not an indication, however, that the principles of stabile making should be introduced pedantically to young children. Children who are at the presymbolic stage [3] in art are linked to an intuitive sense of exploring and experimenting. Their resultant pieces appear as abstractions, but actually they cannot be abstract.[4] Children at this stage are not cognizant of depicting life or organic form as symbolism. They usually approach materials without preconceived notions, creating within themselves an intuitive awareness of the characteristics and possibilities of the materials. This search and discovery is a natural reality that has always existed and can be found at all ages, especially where new materials are involved. This, in fact, is what the task of the basic course is at the Bauhaus. The constructivists began to take courage for work of their own on a more intellectual and sophisticated level. Their preliminary efforts, however, were by no means more meaningful or creative than those of the young children. This buoyant spirit of discovery is the essence of the creative process.

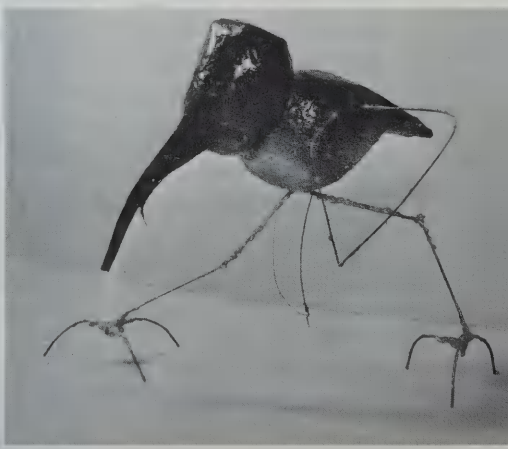
To experience the intrinsic qualities of the materials and related principles adds to one's knowledge of the world, and because he has had the opportunity to use these materials to construct—unhampered by traditional standards—his concepts of form and space relationships will be enlarged.

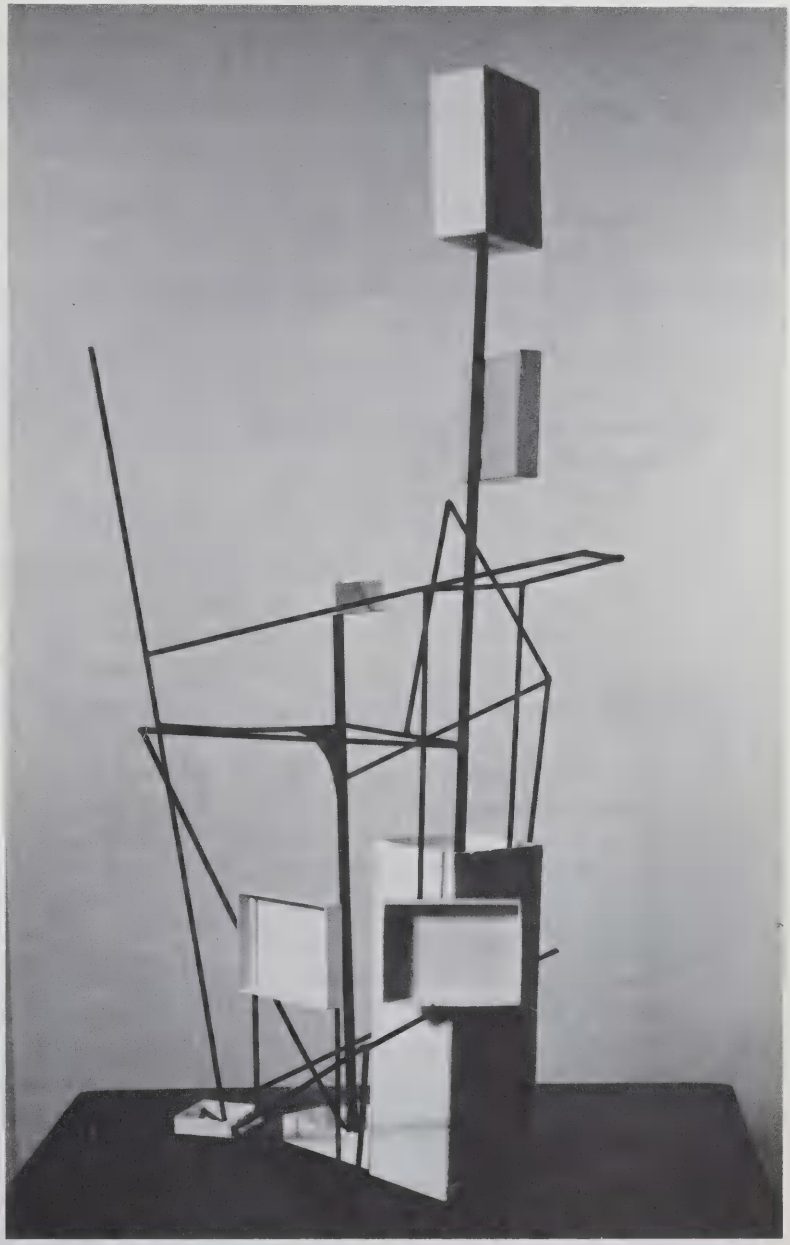
The teacher should not restrict the children by standing idly by but, on the contrary, should attempt to arouse within them an interest in exploring the intrinsic and aesthetic qualities of the materials. He may point out and call to the children's attention the linear quality of string, reed, and wire; the surface plane of paper, plywood, and sheet metal; the mass forms of clay, and wooden blocks; the texture of cloth, sandpaper, felt, sponge, and wood. Without guidance, so many properties of so many wonderful materials may go undiscovered.

[3] Presymbolic is a stage in creative development in which children explore, discover, and express their emotions. It preceeds the producing concept of "things." It is sometimes referred to as the scribble or manipulative stage.

[4] To "abstract" is to separate out of the natural appearance of things the elements of visual reality, for example, the color, texture, shape, or linear quality of a leaf. Most children and many adults are not capable of such intelligence.

The slightly older children are not as fortunate as those at the presymbolic stage, who are free of intellectual inhibitions. They cannot manipulate materials without some compromise with illusions of nature. The result usually is a series of representational sculptures mostly in the forms of animals and human beings, and miniature buildings made of wire, blocks of wood, cardboard boxes, and a combination of these and other materials. It is difficult for the symbolic age group to shake the influence of traditional ideas. If they are forced to "abstract," they may become impersonal and their products ambiguous. On the other hand, without proper guidance, subject matter can become a deterrent merely serving to distract from the basic principles of three-dimensional constructions. Subject matter for these children represents a commitment. Without this commitment or personal involvement, constructions would be of little value. These children must be free to represent, but they must also be made aware that in nature the spatial qualities play an essential role no less important than color, form, and texture. Nature is also defined by space, movement, weight, or the lack of them. These abstract qualities are to be respected and incorporated in symbolic representations if such art is to be meaningful and expressive. Regardless of the approach used, the students should be made to obey the laws of the materials and to recognize content. The success of art is not determined by whether it is abstract or representational but by the artist's insight and the adroiteness with which materials are utilized to express ideas. A good stabile is one in which *idea* or intent harmonize with material, regardless of style.





"Box Sculpture" (discarded cardboard boxes and doweling) by a college student, Syracuse University.

As the students progress they move from an intuitive approach to design, through symbolic representation, to an intellectual manipulation of materials into absolute relationships without any compromising with naturalism.

There is no definite starting age, nor is there a specific way of introducing stabile construction to young children. We have all observed that when a very young child is given a block of wood to manipulate, he begins to experience its properties. He becomes sensitive to and intuitively aware of its squareness, size, weight, texture, stability, and degree of solidity. These begin to formulate the basic experiences that help him understand his universe and from which stabiles are eventually constructed. When he is given two blocks to play with and he stacks one on top of the other, he has had his initial experience in utilizing the knowledge and actually constructing.

Children in the Creative Art in Education Clinic at Syracuse University are, at the age of three, given the opportunity of manipulating wooden geometric forms, textured materials, paper, clay, and large beads. As they become proficient in the manipulation of these materials they are furnished with adhesives so that, as their fancies dictate, they may experience the pasting of a variety of prepared materials, exploring their constructive possibilities and becoming cognizant of balance, cantilever, and open spaces. Many of these children are from progressive homes and have had similar experiences long before enrolling in the Clinic. Their ability to create with these materials would indicate that abstract qualities can be experienced at the age of two, or even at a younger age.

As children progress in their ability to handle new materials, they may be offered the opportunity to experience more complex construction techniques. They may be given the opportunity to define the limits of a given medium; to saw, drill, and glue wood; to cut and sew cloth; to tear, paste, and fold paper; and to twist, bend, and coil wire. The young children intuitively, and many of the older students intellectually, create constructions that emphasize an interplay of abstract principles. Others may be more concerned with their expression through subject matter. Although students who have a desire to express themselves literally should not be discouraged, it is wise to keep in mind that subject matter usually has a tendency to distract from the first principles of stabile construction.

It is likely that those who choose to express themselves literally have not been properly orientated toward stabiles. The desire for literalistic associations in stabiles can be overcome by encouraging the students to explore materials and the principles involved for their own sake, and having them substitute symbols for figurative representation. Having the students become preoccupied with problems that cannot be embodied in natural forms so that they must rely on new forces of expression is usually effective. This effectiveness, however, is dependent upon the extent of their understanding and personal commitment. In time, more abstract spatial effects can be introduced to and absorbed by the traditional-minded students.

The early attempts of preschool children at constructing are subconscious, spontaneous reactions to the character of the materials and the principles involved in their uses. School children are more concerned with symbolism and should be taught to incorporate the characteristic of the materials into their expressions. The principles of teaching stabile construction to the high school student or amateur adult, however, should be more in accord with the principles of Bauhaus education. It recommends a systematic approach toward unprejudiced experimentation with materials. In his first contact with materials the student is encouraged to attempt to discover all the effective possibilities. Should the material be paper, the student is encouraged to consider using it in an unorthodox way. He should try folding, sewing,

bending, pinning, curling, and fluting it; using it vertically; and slitting and joining pieces together and investigating its potentialities. If the material is glass, aluminum, wire, wood, rubber, screen, or clay, the student should likewise consider the pecularities of the material. Having defined the limits of a variety of media, the student should approach construction through the study of the laws of proportion, form, space, light, rhythm, texture, color, motion, tension, and contrast.

Mobiles

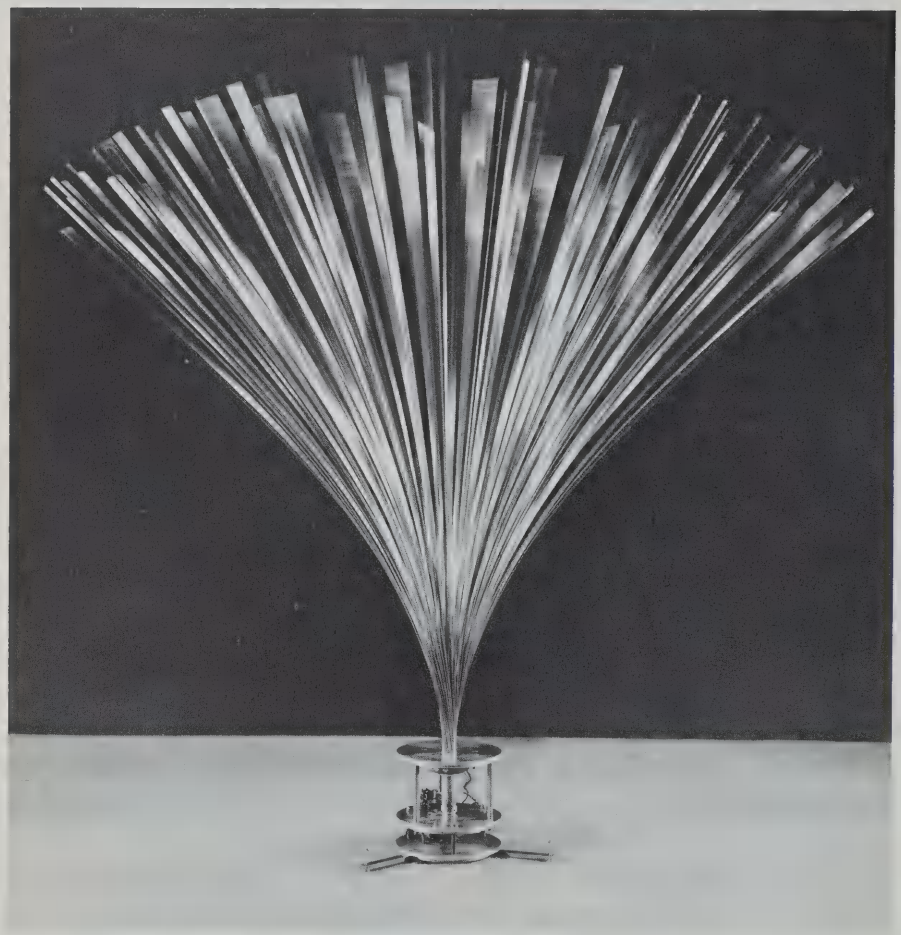
There is a tremendous variety in the styles of constructivism today. Depending upon the interest of sculptors, they may be very simple or quite complicated; be manifested in an open composition or a closed, complex one; or integrate form in space or deny its very existence. Each is designed in accordance with the principal intent of its creator. Although one sculptor may define space, another emphasize the relationship of form in space, and still another create works of art embodied solely in its motion, they all theorize about the world in which they live. Started in 1913, constructivism reached its peak in America nearly three decades later with its conquest of motion. What had been stationary abstract sculpture became actual moving forms in space. The influence of the kinetic sculpture of the Russian constructivist Gabo and the machine-propelled works of Marcel Duchamp are evident in Alexander Calder's earlier motorized sculpture.

At first, objects placed in motion were limited to a single pendulum movement resembling a metronome. Others were confined to a constant set pattern of oscillation or rotation much like a thaumatrope, a zoetrope, or a rotary optical precision apparatus that literally obscures the original forms, creating a completely original image.

Encouraged by his animated toys and fascinated with the complex principles of visual rhythms, Calder continued to experiment and began to incorporate movement into abstract designs without the aid of hand cranks or electric motors. To these abstract, geometric configurations Duchamp gave the name mobiles. To him they represent the apogee of kinetic sculpture. Whereas most other sculptural forms, including stabiles, attain only the impression of movement by suggesting physical action, rhythmical and linear sequences, contrast of texture, and the graduation of color value, the mobile actually moves. The intricately balanced shapes are designed to define space and to be set

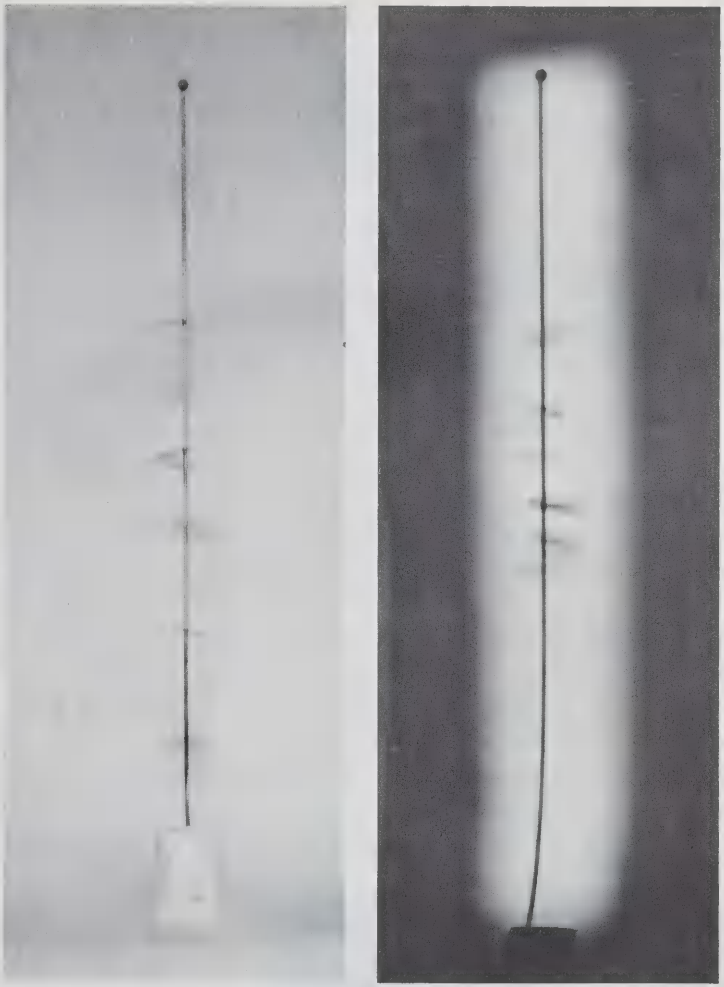
"Lobster Trap and Fish Tail" (steel, wire, and sheet aluminum) by Alexander Calder. Photographed by Soichi Sunami *(Collection the Museum of Modern Art, New York. Gift of the Advisory Committee).*

in perpetual motion by the aid of the slightest air currents. Calder had reached the point of incorporating motion as the fourth dimension in sculpture. His contacts with Piet Mondrian, as well as Hans Arp, Jean Helion, and Theo van Doesburg, the architect who founded the non-representational artist's "abstraction-creation" group, influenced him to turn his mobiles from representational forms to abstract compositions. It was actually Joan Miro's abstract fantasies, however, that appealed to Calder and actually influenced his free-forms, turning them into unpredictable, natural movements. In this way Calder was able to substitute the more dynamic principles of the modern world for the static and figurative art of the Classic and Renaissance periods. His mobiles speak of a scientific age in aesthetic terms. They represent a fresh, new, spatial conception indicative of our contemporary era. Although supported by artists from different countries, the mobile is strictly an American innovation comparable to the contribution of jazz in the field of music.



"Fountain" (stainless steel) by Len Lye. Photographed by Geoffrey Clements. *Courtesy Howard Wise Gallery, New York City.*

Sculpture, unlike painting, has undergone a drastic technological and aesthetic revolution. The motor-driven sculpture at left, based on the moiré phenomenon (optical illusion), generates (by its rotating steel fronds) shimmering patterns resembling an active water fountain. Dr. Gerald Oster of Polytechnic Institute in Brooklyn now claims that such geometrical moiré patterns can be used to solve problems in theoretical physics and aerodynamics.



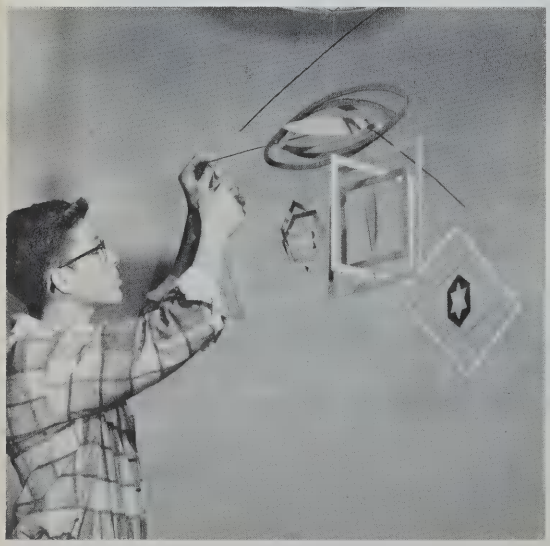
"Moiré Sculpture" (steel) after Susan Swinarrd, Moore College of Art, Philadelphia, Pennsylvania.

Sculpture produced by motors, magnetron pole magnets, and the use of gravity result in the added dimensions of sound and interesting kinetic patterns. Those above were produced by dropping four galvanized tin can lids threaded on a steel rod by a carefully placed hole, slightly larger than the diameter of the rod, at their outer edge. Left, photographed with a lens aperture of 16 at a speed of .08 a second. Right, photographed with a lens aperture of 22 at a speed of 3 seconds in a dark room with the image illuminated by a slide projector.

Characteristics of mobile materials

Many of the materials suggested for use in making collages and stabiles can also be used for mobiles. These eclectic materials include wire, string, yarn, reed, cardboard, sheets of aluminum, tin, wood, screen, and plastics. In considering the materials for a mobile, however, the student would do well to keep in mind the first principles of motion. There are, for example, motionable materials susceptible to the slightest impelling causes such as air currents and mild gusts of wind. We are, perhaps, greatly indebted for our concept of the principle of motion to the ancient sailors who fashioned fabrics, animal skins, and mats of woven rushes and raffia as sails to catch the wind and propel their crude simple boats; and to our observations of birds in flight, the kite, leaves that blow in the breeze, and the fast, fleeting movements of objects of our modern era.

Many materials are distinguishable by their thin, light, and flat sail-like characteristics. Newton's second law of motion tells us that the smaller the mass the greater the acceleration, but at times great acceleration may not be a desirable feature. It would therefore be appropriate to consider certain material as an anchorable element in contrast to a more effortlessly mobile element. In such cases, bolts and nuts may be most appropriate. Degrees of acceleration may be determined by the size, weight, and the perforation of mass. A four-inch square of screen will allow air to penetrate and therefore be less mobile than a four-inch square of solid sheet metal of equal weight.



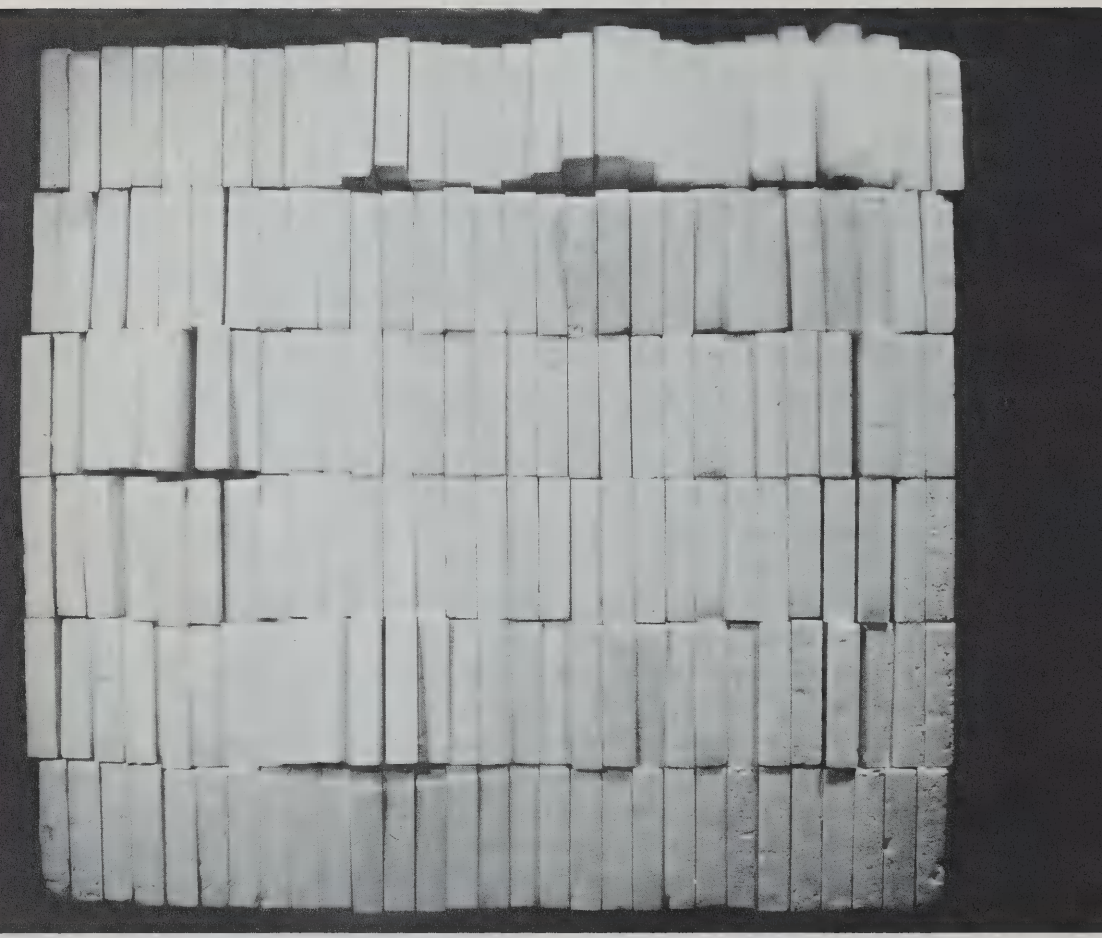
A high school student making a mobile. *Courtesy Mrs. Lucile Jenkins, Van Horn High School, Kansas City, Missouri.*

Most of the materials used are considered in terms of the principles of *ideal motion,* that is, motion exclusive of resistance or friction. This may be of little concern to the young children but it is an important concern of the more mature and venturous student. The wise teacher will take into consideration this factor that affects motion—principally friction. The joining of one section to another should be designed to secure a determined reaction. Certain metals against other metals cause friction, while others develop less friction. Lubricant substances such as oil lessen friction, but for our purpose this would not be practical. Mobility is most likely obtainable through the use of elements containing ball or roller bearings or fish swivels. Fish swivels are usually available in a number of different sizes and can easily be obtained at a hobby or sports shop.

For those parts that are usually considered more practical or functional than aesthetic—such as the arm that holds the major forms together—wires, steel rods, reed, strips of balsa, and doweling are perhaps the most appropriate. Although the principal function of these arms is to connect and support the larger forms, they in their own way affect the all-over design of the mobile. Curved arms, for example, give the mobile a more dynamic and rhythmic composition. Straight-line arms, of course, can at times be most effective depending upon the design as a whole.

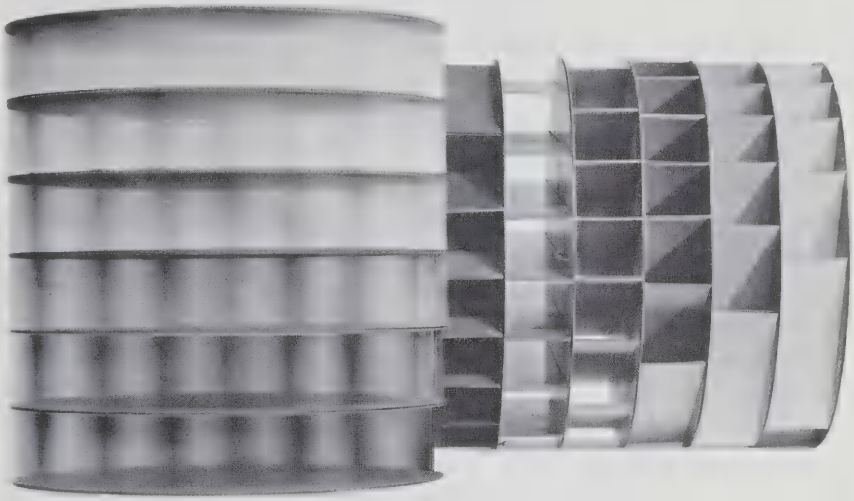
Some materials that are conducive to space and motion concepts are transparent glass, plastics, and celluloid. They create a feeling of lightness and airiness. Steel rods, string, yarn, coke straw, reed, wire, and doweling are utilized for their linear quality. Flat, two-dimensional sheets of materials that change their shapes rapidly and extremely as they rotate, suggesting greater motion, are also appropriate mobile-making materials. The shapes of things can do much to suggest motion. The large biomorphic shapes portray a feeling of slowness, while thin, triangular, streamlined forms are more representative of movement and speed. Color can also be an effective element in defining space and motion. The brighter colors usually add vitality, lightness, and gaiety.

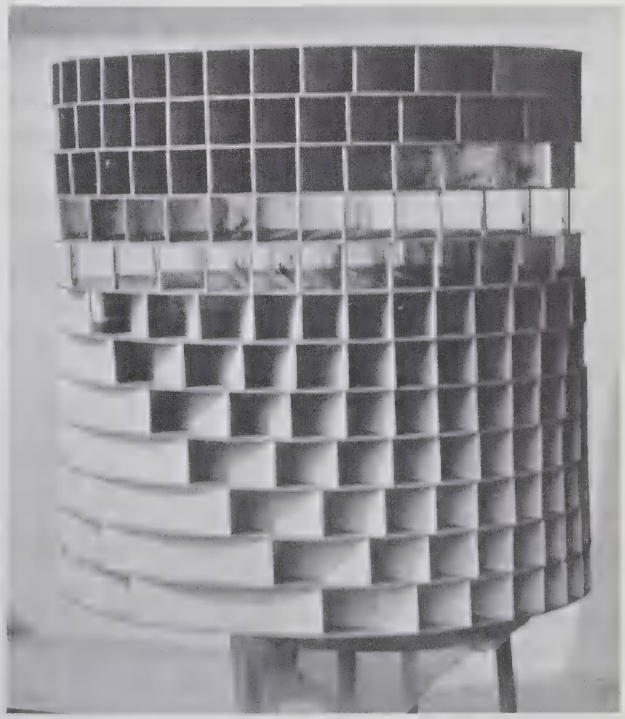
There is one essential that must not be overlooked: space itself. Although it is not a tangible element, it is definitely a mobile sculptural element of the highest importance. Mobiles are designs moving in space. Merely to suspend bits of wire, string, pipe cleaners, paper,



Above, "Pulsating Structuralism 1959" (rhythmic deformation of a modulated surface with detached elements, motorized) by Gianni Colombo, Milan, Italy.

Right, "Acentric Structuralization 1962" (cyclic regularities of light and rhythmic mutations of chromatic tone, simultaneously determined by the movement of two rotating cyclindrical cellular bodies according to the vertical and horizontal axis) by Gianni Colombo, Milan, Italy.





colored feathers, and corks with no purpose or intent toward movement does not constitute a mobile. In a true mobile the principles of movement—undulation, rotation, oscillation, vibration—as well as the definition of space and design organization are essential.

Tools and equipment

The tools and equipment for making mobiles can be few and, in fact, very simple. Sometimes no more than a pair of scissors is needed. At other times one may need cutting pliers, a saw, a hammer, a stapler, a knife, a screwdriver, needles, and adhesives. The more advanced and experienced student may call for all the tools and equipment used in making the most complex of stabiles, and in addition many other tools relative to such unorthodox methods as sand blasting, casting in the cire perdue method, patinaing, brazing, electroplating, and centrifugal casting. There is actually no limit to the type of tools and equipment that can be used in making a mobile.

Procedure

Although motion is the most important characteristic in mobile making, we would do well to keep in mind that every work of art that moves is not a mobile. Mobiles are definite problems in defined motion. Far too many are nothing more than an array of completely unrelated objects suspended from above. However, we must not overlook the fact that for the very young children these simple suspended objects can actually represent the first step toward learning about mobiles. The youngest child is capable of experiencing the first principles of a mobile in simple constructions. He should be encouraged to suspend objects on a string so that they swing freely. The teacher should motivate the children to experiment, to help them become aware of different movements such as oscillation and rotation, as well as with balance and space designs. Children who have experienced the principal movements soon grasp the idea of rotating an object on a string and comparing it to a merry-go-round; or combining a series of suspensions on a crosspiece, incorporating the principle of balance and oscillation which they have so often experienced on a see-saw or by observing weights on a scale.

For the more advanced students, the designing of a mobile may begin on a drawing board with a very simple idea—perhaps one or two shapes which, in turn, may suggest others. These drawings are to help the student work out his basic ideas, but under no circumstances should

he refine the drawing to the degree that he becomes apathetic toward the basic principles of a mobile. Actual motion and space and the three-dimensional effects cannot be justly depicted on a two-dimensional surface. It is usually helpful to make preliminary or "thumbnail" sketches, but the creator must dare to adopt, arrange, and rearrange his forms, improvising in an effort to perfect his ideas.

Although an air of improvisation is closer to the spirit of creating mobiles than didactic methods, a few technical hints may prove beneficial. It is always best to begin from the bottom-most unit. Design the initial unit (bottom) so that it balances, not necessarily in terms of size or aesthetic quality, but in terms of actual weight. Do likewise to another of the bottom units and then balance the two, forming a composite unit. Continue the procedure until the mobile is complete. Adventurous experimentation can lead to an extraordinary mobile with vivacious movement and virtuosity.

There are a number of basic ways to secure forms to the arms that support and separate them. Most, of course, are dependent upon the desired effect. Vertically attached forms are susceptible to greater cross-breezes, and since the mobiles are suspended by a single axis, they cause the mobile to rotate. Since each unit may be suspended by a separate pivotal point the rotations may be clockwise and/or counter-clockwise. Horizontally attached forms are more susceptible to up and down drafts, which cause them to undulate. Experimentation will undoubtedly produce a greater variety of interesting effects.

"Seven Blacks on Black" (metal) by Alexander Calder. *Courtesy Perls Galleries, New York City.*

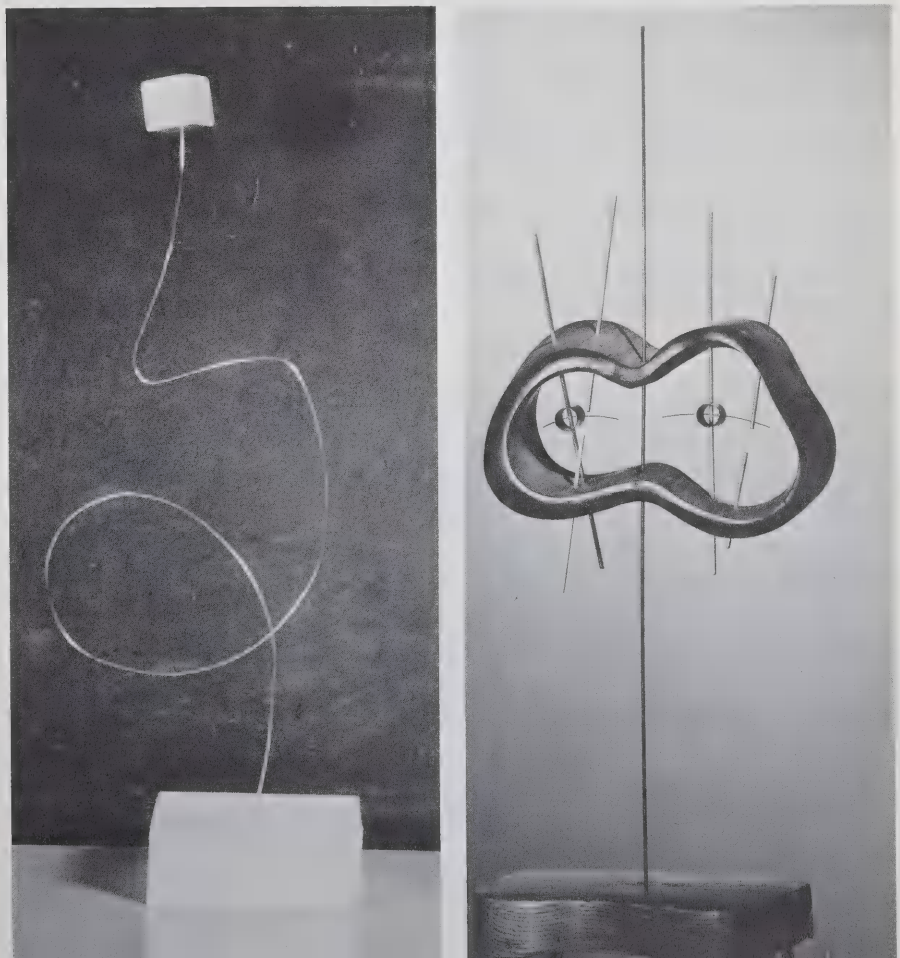
"The Acrobat," 1964 (unique bronze), by Robert Mallary, New Rochelle, New York. *Courtesy of the artist.*

Robert Mallary, who refers to himself as a neo-dadist or an assemblagist, uses a number of tuxedoes impregnated with a plastic to create a metaphorical substitute for the human body. The tuxedoes, which Mallary buys by the dozen, are mangled into abstractions, turned inside out, and redefined to evoke a human presence through simulated stance and posture and suggested movement. Mallary states that in his creations he is attempting to develop an iconography of absurdity and anxiety. His unorthodox technique will, like most innovations, undoubtedly become orthodox and eventually understood and appreciated by a greater number of people.

Vibratiles

Any construction that actually moves by means of air currents, electric motors, or hand cranks is, in reality, a mobile. In this respect one might rightfully refer to a vibratile as a standing mobile. Its construction is not unlike that of a stabile or mobile. It caters to space, refutes mass, and has a tendency to emphasize the linear. The movements of a vibratile, however, are not as perpetual as those of the mobile. In fact, it is not easily moved by air currents. The difference in motion is so distinct that the two forms have the right to claim their

Left, "Vibratile" (wire and wood) by a young child. Right, "The Hypnotist" (wood, copper tubing, aluminum, and steel wire) by George Laisner, Pullman, Washington. *Courtesy of the artist.*



own entity. Although the vibratile may be an offshoot of the mobile, it has its own peculiar virtues determined by the nature of its vibrating movements. George Laisner's simple sculptural composition was designed to vibrate as a pendulum, producing an active hypnotic sensation.

Unlike the mobile, the vibratile is usually put into motion by the constant intervention of the spectator, that is, it usually has to be sprung into action. The vibratile is generally considered a more advanced form of sculptural project, one thought too difficult for the young children to construct. This, of course, is not necessarily true, for even the youngest of children can usually make simple vibrating constructions. The vibratile on page 163, for example, was constructed by a four-year-old. It was made out of a piece of nine-gauge piano wire with an attached block of colored wood that was just heavy enough to cause it to oscillate gracefully when put into motion.

In addition to vibrations, the principal feature of the vibratile is *sound.* Many vibratiles are so intricately and purposefully constructed that when they are put into motion the various parts come into contact with each other, enlisting a tinkling or jangling tune that is pleasing to the ear much like the Chinese wind bells or harps. Naturally, the materials required for making vibratiles are of the resilient and rigid nature such as stainless steel, brass, and nickel-chromium. Piano wire is very good and quite easy to acquire, but comes in coils that are rather difficult to straighten. The use of accessories for gong effects adds interest and opens up new horizons in sound effects.

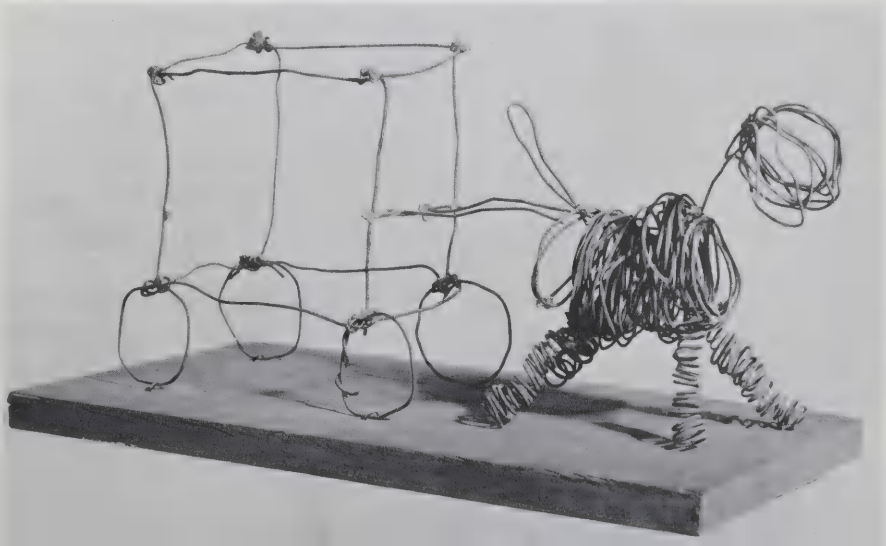
Wire Sculpture

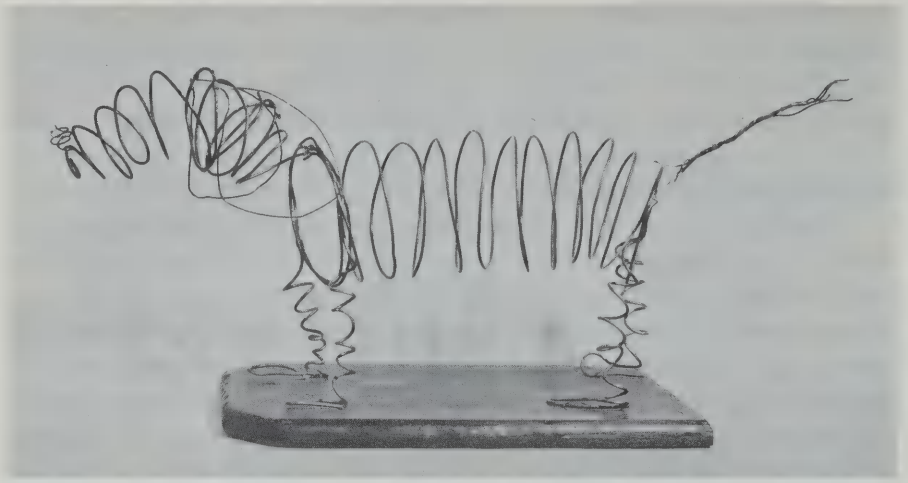
The use of wire in making sculpture is comparable to "drawing" in space. It introduces a linear, three-dimensional quality of art to the students without the necessity of their overcoming the discipline of the harder, massive media such as wood and stone. Wire makes possible *sculpture a claire-voie,* an open, transparent sculpture that extends art-type experiences beyond the traditional idioms of the past and helps us comprehend the modern principles of sculpture. Although wire sculpture definitely has its limitations as an aesthetic form, it has the qualities of contributing to the experience man needs to promote his individual potentialities and creating new sculptural visions in more permanent materials.

Whereas wire sculpture has never been taken seriously, especially for those who are accustomed to interpreting sculpture as a massive, cumbersome, literal symbol, it does lead and contribute to the introduction of welded sculpture. There is little doubt of the ostensible role that welded constructions have played in establishing the principles of twentieth-century sculpture.

There are a number of preliminary exercises that may be used to introduce the student to the linear quality of wire sculpture. Line drawings with pencil on a light-colored surface, for instance, may well be considered a "warming-up" exercise. It is important, however, that before the drawings can become static and stereotyped the teacher encourage the students to draw with string or reed, and create linear designs with coke straws, pipe cleaners, colored balsa sticks of assorted colors, and other such linear materials.

The students may then be instructed in "drawing with wire," twisting, bending, and fashioning it into two-dimensional representations and designs. These creations may be secured to a cardboard base with tape or staples. At the beginning, the results will tend to be representational; this is understandable. But as the students progress, it is the teacher's responsibility to guide them toward an awareness of the more abstract, harmonious relationship that can exist between material and idea. By allowing the student to find his own way, discovering the aesthetic function of wire in an accepting environment with no pressure applied, the teacher is more likely to help the student develop aesthetic sensitivity.





Attempts at three-dimensional forms drawn in space at first retain a certain flatness much like actual pencil drawings, but eventually they are carried toward a convincing three-dimensionality. There is in the "Horse and Carriage," seemingly, an association of physical form and aesthetic concept. The horse, for instance, is depicted in a solid, dense form while the carriage is without weight or density. The youngster modified his materials to carry out his idea of a horse, and in so doing negated the fundamental characteristic of wire. On the other hand, the wire integrates perfectly with the volume concept of the carriage. Might it not have been more appropriate to have used clay, wood, or some other bulky material for the horse? To direct the child to use clay for the horse, of course, would be questionable if not presumptuous. It is most imperative that he be provided with the opportunity to discover and develop the interpretive source within himself.

The student who created the wire sculpture on this page was perhaps a little more successful. He started to represent a dog with wire. As the sculpture developed it became less of a direct portrayal of a dog and more of a line in space existing in its own right. In defining space the wire depicts a greater reality than it does in its use of depicting a dog.

Space for the young artist is usually not considered a concept of form, but as he becomes sensitive to and more integrated with it he begins to emphasize it as a positive element and space takes on a sense of reality.

Naturally, wire is considered the principal medium in making wire sculpture. In most cases it is flexible, yields easily to the slightest pressure, invites experimental and explorative manipulation, and can be easily mastered even by the youngest children. As one of the newest media in the field of art it does not have to contend with prototypes and technical inhibitions. It has the power to stimulate curiosity, to suggest innovations, and to allow for the simplest as well as the most complex ideas to be realized and actualized in visual form. It is a medium that is pleasing to handle, soft, warm in appearance, rich in sensory experience; it is suggestive of space, line movement, and the sublimation of bulk. Its unique linear and calligraphic qualities stir the imagination and eliminate the need for much predetermined instruction.

Wire is available in a number of suitable varieties. There is iron or stove pipe wire, which can be purchased at any hardware store. It is an inexpensive wire pliable enough to bend and strong enough to withstand abuse. Copper wire, perhaps the most preferred, is a little more expensive but its warm and inviting quality is worth the price. It is often available in small lengths, gauge 10 to 20, at various industrial plants merely for the asking. Other suitable wires include aluminum, plastic-covered electrical wire which is available in a variety of colors, and chenille-covered pipe cleaner wire.

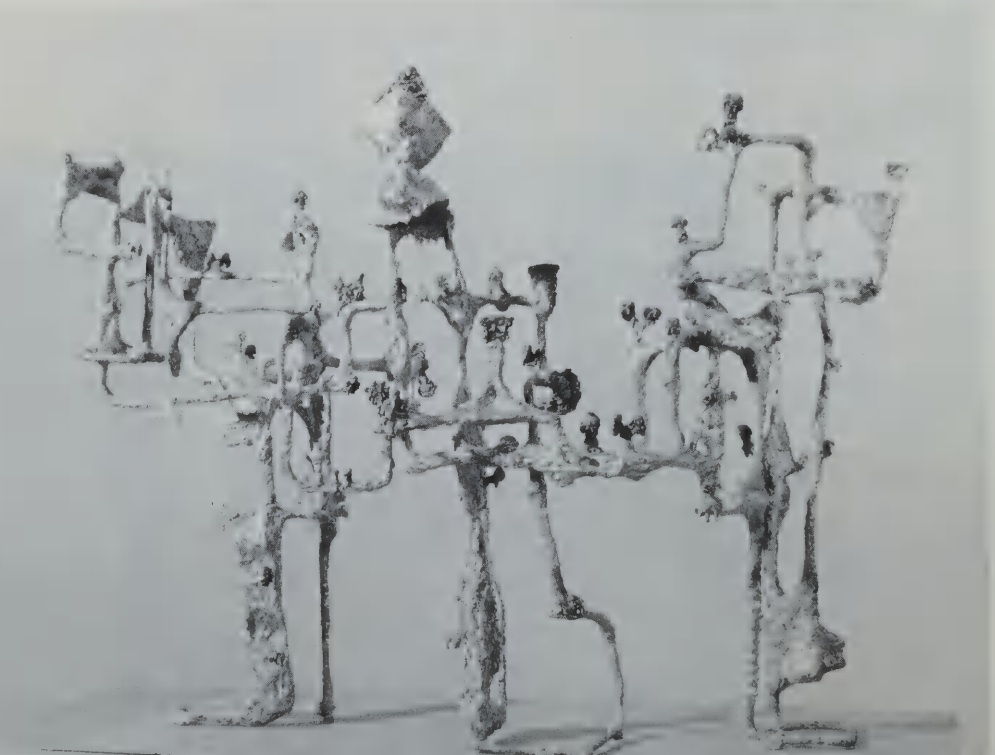
Figures (sculp-metal over wire) by an elementary school child. *Courtesy of the Creative Art in Education Clinic, Syracuse University.*

The need for accessories will inevitably follow the experimental approach to wire sculpturing. Individual interest and ingenuity will undoubtedly call for a great variety of materials. The more imaginative an adventurous student will use such accessories as cloth, sponge, feathers, wood, cotton, sheet metal, and cardboard. He will also be interested in transparent as well as opaque materials. There are actually very few materials that cannot be incorporated in creating a wire sculpture.

Tools and equipment

One of the most fortunate things about the use of wire is that it can be shaped solely with the hands. There are, however, certain basic tools that will facilitate the use of wire in making sculpture. Perhaps the most essential piece of equipment is a pair of wire-cutting pliers. These would be especially essential to the more mature individual who may be at the stage of creating wire sculpture that calls for compositions involving a number of pieces of wire.

"Procession," 1955–56 (wire, copper, various bronzes, and silver), by Ibram Lassaw. Photographed by Oliver Baker Associates *(Collection of the Whitney Museum of American Art, New York).*



For the young artist who may simply draw in wire, sheets of cardboard or plywood may be of use as background material upon which the creations are stapled or taped. In this event, scotch tape, masking tape, a stapler, or a tack gun would be most appropriate. For the student who creates wire sculpture in-the-round, blocks of wood could be used to serve as a base.

The more adventurous student may find it appropriate to fasten pieces of wire together with solder. These students would require an electric soldering iron, soft lead solder, and a sheet of fire-resistant material to protect the table or desk. The high school student and amateur sculptor may prefer to use an acetylene torch. For the more complex pieces a table vise, hammer, metal files, emery paper, and carborundum wheel would be welcome additions to the sculptor's equipment needs.

Procedure for wire sculpture

Young children should be permitted to approach the use of wire spontaneously, sensing its potentialities, exploring its possibilities, and reacting to its immediacy with no predetermined idea in mind. In the introduction to a new medium the student should never be forced or told to make something. Ideas usually develop in the process of one's

becoming acquainted with the characteristics and potentialities of a given medium. The beginner should be given ample opportunity to do it for himself and the chance to arrive at his own unique style of expression. Should the teacher attempt to give specific instructions, the student is most likely to disregard his sovereign right to self-discovery and creativity.

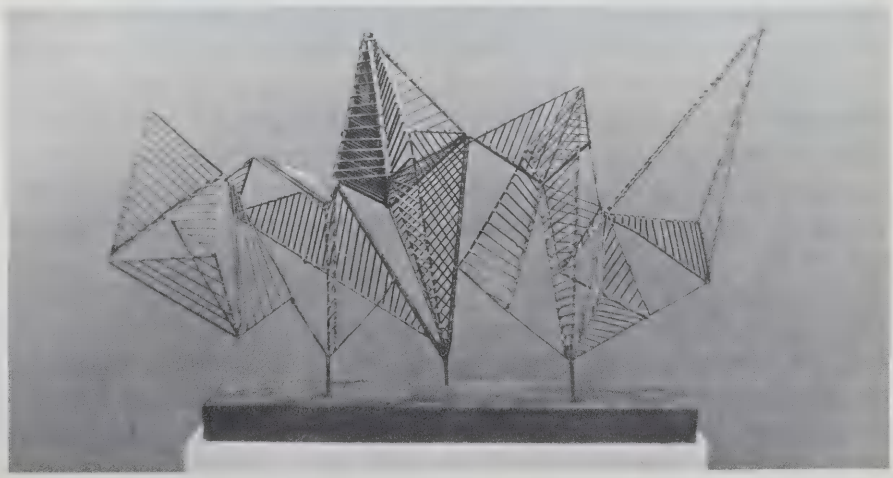
The wise teacher is one who will encourage the young artist to work with a single strand of wire at the beginning, simplifying the process and helping him to select the essential movements in attempting an integral whole. Because wire is suggestive of drawing, the young child and the inexperienced student will react to it by making animals and people. Only after they have become sensitive to its linear and space-defining quality will they attempt to apply abstract principles and their own personal interpretations.

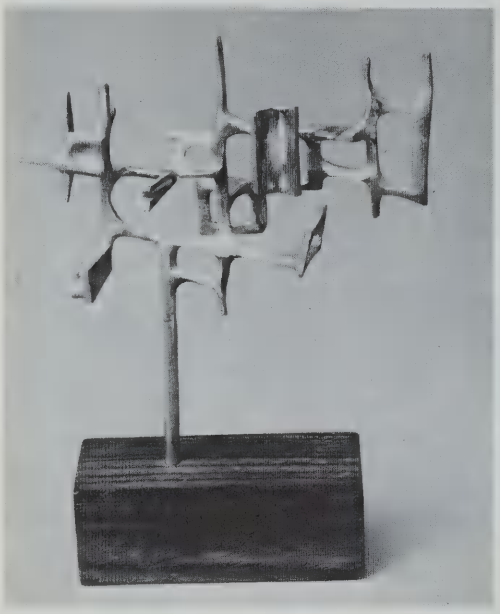
Wire is one medium that is generally preferred for the purpose of assisting the student in the rediscovery of his aesthetic sense. The play of wire in space has a calligraphic humor, as is evident in many of Alexander Calder's early wire caricatures of the well-known celebrities of his time. There is a degree of freshness, gaiety, lightheartedness, and sometimes a delightful trifling and wry amusement in such sculpture. Wire sculpture seems destined to remain independent of the seriousness of conventional sculpture and to retain a character that is capricious and juvenile.

Welded Sculpture

The welded sculpture we see about us today may well be attributed to surrealist fantasy that was prevalent at the end of the twenties and the beginning of the thirties. Such men as Pablo Picasso, Julio Gonzalez (who incidentally was influenced by Picasso and who in turn actually instructed Picasso in the techniques of metal work), and Jacques Lipchitz were instrumental in introducing the welding of metal as sculpture. Other prominent artists who contributed to the movement include Henry Moore, Henri Laurens, Georges Vantongerloo, and Alberto Giacometti. Among the contemporary contributors one might list such men as Herbert Ferber, John Rood, Seymour Lipton, Theodore Roszak, David Smith, Ibram Lassaw, Harry Bertoia. The names of such women as Katherine Nash, Lilian Saarinen, and Mary Callery may be included on this impressive list.

Welded sculpture, as well as wire constructions, are created in such a way that the structure and character of the material always remain evident, contributing to the character of the idea. Although welded sculpture frequently employs form and mass, its principal consideration, like that of wire sculpture, is space. Welded sculpture may be considered as merely an extension of the process of arriving at somewhat the aims of wire sculpture. Welding is, however, undoubtedly more complex and difficult than the soldering of wire sculpture, but certainly within the range of ability of most high school students.





Untitled cast bronze by Ned Griner, Muncie, Indiana. *Courtesy of the artist.*

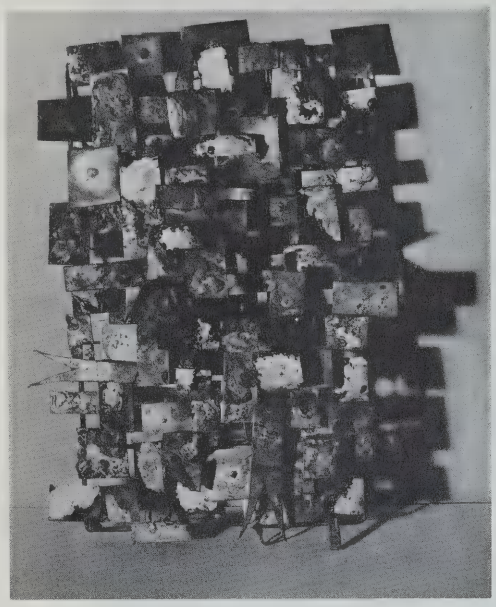
Welded sculpture undoubtedly requires a greater precaution than stone and wood carving but is by no means as time consuming nor does it require as rigid a discipline. Like the mobile, stabile, and vibratile it belongs to an industrial-minded people. The basic principle of joining pieces of metal together by the use of heat, however, goes back many centuries. For those artists who have created jewelry and participated in silversmithing, welding is considered merely an outgrowth that has lost its application to personal ornamentation and decoration and has taken on a different direction. For those who have had the opportunity to experience jewelry making and silversmithing, welding sculpture has a greater meaning, and as the result they themselves have acquired a greater capability for welding. Creative jewelry is more than a display of technology. It is in reality symbolic of one's own expressions of universal truths aided by his display of skills, techniques, and knowledge.

Characteristics of materials

Steel is the most appropriate medium for welded sculpture. Coat hangers, strangely enough, are usually made of the finest steel and can be found in abundance at little or no cost at all. A slight disadvantage in using coat hangers, however, is that the lacquer coating that burns off in the process produces an undesirable odor. Welding rods of vari-

"Bird in Space" (bronze) by Constantin Brancusi. Photographed by Soichi Sunami *(Collection, The Museum of Modern Art, New York).*

ous thickness can be purchased in one-yard lengths at very reasonable prices. It is advisable to purchase several different sizes. For the beginner, one-eighth inch is the most appropriate thickness. Sheet metal as well as odd pieces of steel found at a junkyard are also suitable for creating welded sculpture. For the more adventurous sculptor other metals such as bronze, lead, aluminum, stainless steel, nickel silver, copper, brass, cast iron, or a combination of these metals may be taken into consideration. Steel, naturally, is the least expensive, easiest to obtain, and most workable.



Tools and equipment

In addition to steel rods and scrap metal it is imperative in welding that the older students have access to means of obtaining excessive heat. The acetylene mentioned previously will not be adequate. For welding one needs terrific heat approximately 6000 degrees Fahrenheit. To obtain such heat a mixture of oxygen and acetylene is needed. It is for this reason that only the cautious and serious-minded high school student should be encouraged to work with the oxyacetylene torch.

Other pieces of equipment that are needed in order to weld are a heavy steel table, preferably covered with brick and mounted with a small vise; a pair of dark glass goggles and asbestos or leather gloves to protect the eyes and hands, respectively; a flint striker to ignite the acetylene (matches or a candle may be used but they are not as convenient or as safe); appropriate clothing, preferably a leather apron and skullcap, as well as an old pair of shoes; a hack saw; steel brushes; C clamps; tongs; pliers; hammers; an anvil; and, of course, a set of wrenches to operate the tanks. If any brazing is to be done the student will need an alloy and flux. The most commonly used alloys are bronze and copper.

The more experienced sculptors who are interested in and have a strong desire to acquire proficiency in the more complex techniques of welding may find a need for such special equipment as electric shears, which simplify the cutting of sheet metal, and arc welding equipment. These items are fairly expensive for a regular art room or the amateur sculptor's studio, especially since there is very little call for their use.

Procedure for welded sculpture

The technique of welding can be easily and quickly learned. It is, of course, necessary at the beginning to instruct the students in the fundamentals of using the oxyacetylene torch. Basically there are two tanks: one, an oxygen tank, and two, an acetylene tank each with its pressure gauge.

The initial step is to light the torch by first turning on the acetylene slightly and igniting it. The goggles are then placed over the eyes—an

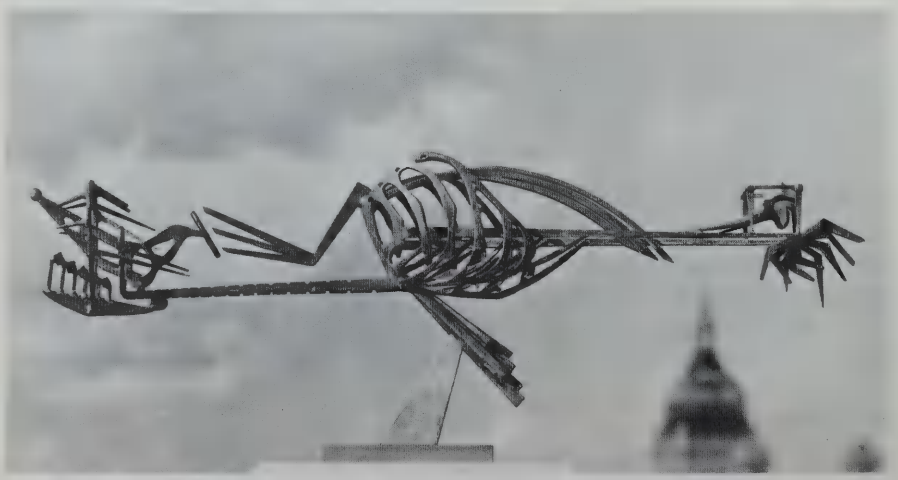
"Sorcerer," 1957 (nickel-silver on monel metal), by Seymour Lipton *(Collection of the Whitney Museum of American Art, New York. Gift of the Friends of the Whitney Museum of American Art).*

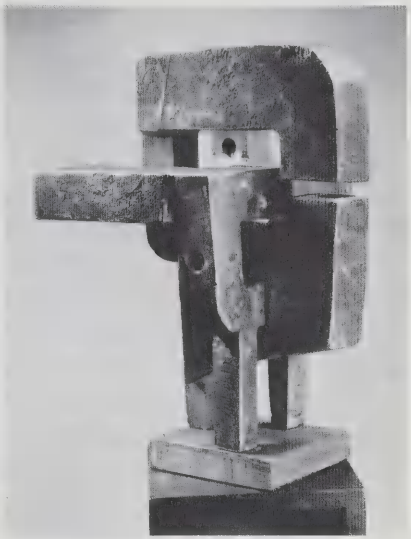
important precaution since the complete combustion of acetylene and oxygen is too strong to look at without dark glasses. The oxygen valve is then turned on slowly and the two—acetylene and oxygen—are adjusted until the yellow-orange flame turns into a blue flame with a white inner core. In setting the pressure gauges, the acetylene should read five pounds and the oxygen should read between five and fifteen pounds, depending upon the type and thickness of the metal; but the oxygen pressure should never exceed fifteen pounds. This will give the sculptor the maximum heat needed to weld steel rods that are a quarter-inch in diameter or smaller.

To begin the initial experimenting it is advisable to first fasten a steel rod one quarter-inch in diameter into the vise to serve as an armature. Next, apply the flame to the steel rod, cutting it into two parts in order to shorten the armature and to get the feel of the torch. Then weld two pieces of the same thickness together, being careful not to touch the hot pieces with the bare hand. One should continue experimenting as fancy dictates. Try applying just enough heat to get the rod red hot and then bending it into various angles; then try bending it into graceful curves. In order to bend the rod gracefully you will discover that the heat must be distributed evenly along the entire section of the rod to be bent.

In welding two pieces together you must not merely tack them to each other but actually fuse them into one piece. The beginner frequently tacks them superficially, permitting the slightest strain to cause

"Royal Bird," 1948 (stainless steel), by David Smith *(Collection Walker Art Center, Minneapolis, Minnesota).*





Untitled iron and steel by Richard Stankiewicz, New York. *Courtesy of the artist.* "Usrh, Space Clasp," 1962 (iron), by Bernhard Luginbuehl. *Courtesy Grace Borgenicht Gallery, Inc., New York (Collection of Mrs. Heinz Schultz).*

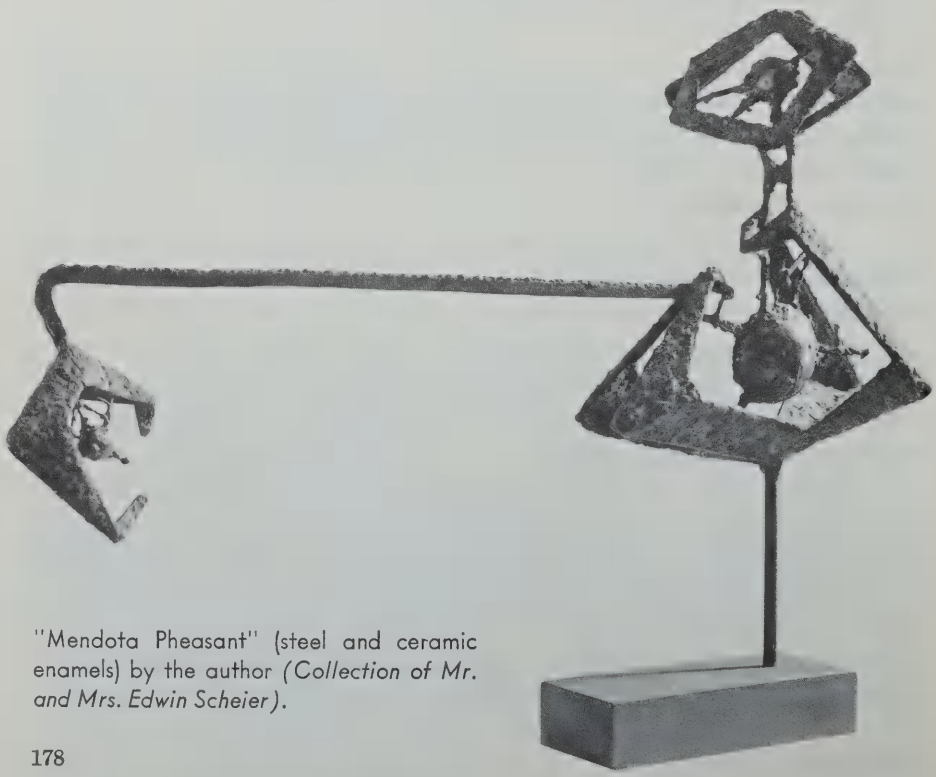
them to fall apart. If the welding is properly done the point of contact with the flame will form into a puddle of molten metal causing the two pieces literally to fuse together. By moving the flame about, you can involve the surrounding metal, causing it to melt and fuse, thus creating a more durable weld.

Once the principle is acquired, try welding a thin rod to the quarter-inch armature. What is likely to happen here is that the finer steel will melt more quickly and drip away from the thicker rod, making the weld impossible. When you are attempting to weld a thinner piece of metal to a thicker piece it is always wise to heat the large piece first. In many cases the red-hot thicker piece will tend to draw the thinner piece to it, causing a more perfect weld.

For the student who may prefer to work with sheet metal there are two courses that he may pursue. First, he may join two pieces of metal by holding them together with a pair of pliers or a set of fire bricks, tacking them at a number of places at close intervals to prevent the pieces from warping or spreading apart under the intense heat. The two pieces are then welded together by fusion. At times a thin rod of the same composition as the parent metal is melted into the joint to add

molten metal, effecting a more secure weld. The second course is to braze the two pieces of sheet metal by applying an alloy at the seam. The alloy serves much the same purpose as the rod previously mentioned but has a much lower melting point. In brazing, it is imperative that a flux be used to clean the parent metal to facilitate the brazing process. Metals that are to be welded together that are more than a quarter inch in thickness should be done with an arc welder. Since arc welding equipment is fairly expensive, requires a 220-volt electrical line (which unfortunately few classrooms possess), and is very seldom required by the amateur, it is more practical and economical to have this part of the welding done at a professional welding shop.

Sheet metal can be used in its natural form, that is, as it is found, or it can be cut either with tin snips or an acetylene cutting torch. Only the thinner gauge metal, however, can be cut by tin snips or electric shears. The thicker metals are cut by being heated with an acetylene cutting torch. The metal is heated until red hot, and just before it begins to become molten a stream of pure oxygen is applied to burn rapidly



"Mendota Pheasant" (steel and ceramic enamels) by the author *(Collection of Mr. and Mrs. Edwin Scheier).*

through the metal, cutting it in two. The acetylene cutting torch is equipped with a special tip and a release lever, which provides the appropriate amount of oxygen for cutting purposes. The cutting torch is not an expensive item and is a necessity from the very beginning.

Precautions

Care must be taken during all welding processes. The intense heat needed to carry them out produces a blinding flare. It is, therefore, necessary to wear dark-colored glass goggles to protect the eyes. Should the flame come into contact with the body it will undoubtedly result in a severe burn. The shower of sparks that frequently accompanies the process can also be dangerous. These sparks are not only capable of causing burns but they can also set one's clothing ablaze. It is for these reasons, as well as others, that a first aid kit with the proper medication for burns and a fire extinguisher should always be at hand.

When brazing with alloys one should avoid prolonged and excessive inhalation of the resultant fumes. Should one become nauseated during a brazing process he should immediately discontinue it; in extreme cases of nauseation he should drink plenty of milk.

Appropriate clothing should be worn at all times. Avoid synthetic fibers and other combustible materials. A leather skullcap, apron, and gloves are recommended. Asbestos gloves are even better but perhaps a little awkward to use. It is also advisable to wear high-cut shoes and cuffless trousers, and to be conscious of pockets that could catch flying pieces of hot metal that might later smolder and burn through the clothing.

Oxygen and acetylene can be highly dangerous. Cylinders containing these components should be handled with great care. They should be safely secured by chains in an area where there is no likelihood that they will be knocked over, come into contact with extreme low or high temperatures, or come into violent contact with each other. The gauges should always be properly opened when in use and tightly closed when not in use. When in use, the cylinders should never come into contact with highly combustible fluids.

Grease and oil are not compatible with oxygen; the results may be a severe burn or possibly a dangerous explosion. It is, therefore, advisable not to wear gloves or clothing covered with grease or oil, or to have greasy rags lying around where they might come into contact with the flame or oxygen.

Finishing Welded Sculpture

The welded construction will by nature be rough in character. If one desires to modify the rough texture it will be necessary for him to smooth the rough weld by using metal files and a motor-powered carborundum wheel. The piece may be polished by using steel cleaning brushes or, if the equipment is available, a motor-driven steel brush mounted on a flexible shaft.

Steel sculpture may be left with its natural fire-burns or it may be finished in a number of different ways. It can be brazed with copper or bronze and polished with a steel brush to the degree desired. Brazing a piece of metal sculpture merely involves metaling an alloy (which has a much lower melting point than steel) over the surface to be brazed. A flux is used to facilitate the brazing. In the process, the reaction of the flux cleans the metal, permitting the alloy to flow freely.

Color may be added if desired by applying a rust-resistant paint or by applying a patina, which may be achieved through the use of various chemicals. The effects of certain chemicals on metal and the methods of obtaining specific colors may be found in manuals on metallurgy. John Rood's book, *Sculpture with a Torch,* reveals a few ideas for finishing welded sculpture as does Jack Rich in *The Materials and Methods of Sculpture.* Both of these books are referred to in the bibliography beginning on page 193.

"Rooster" (sheet metal and bronze) by a college student, Syracuse University.

"The Silver Doorway" (plaster, wood, and glass) by George Segal, New York. Photographed by Eric Pollitzer. *Courtesy of Sidney Janis Gallery, New York.*

George Segal's sculpture is of our time. It continues an attempt to achieve ultimate realism. By casting his images from live models, Segal obtains realism not only in appearance but in size as well. His plaster figures are found in real settings—in a room, with real furniture, in a real bathtub, at a real mirror and sink, or playing a real pinball machine.

Glossary

The following glossary is intended to provide the reader with a practical vocabulary and marginal information for a better understanding and appreciation of sculpture.

Aggregate An ingredient mixed with plaster or cement which does not react chemically. It may be pieces of marble, sawdust, gravel, insulation materials, and the like.

Alloplastic An intellectual extension and adaptation to one's environment.

Alloy A substance composed of two or more metals to give it some desired quality. Brass, for example, is an alloy of copper and zinc.

Alumina A white, amorphous powder aluminum oxide (Al_2O_3), an abrasive.

Arc welder A piece of equipment that conducts electricity through a welding rod to metals which are to be welded together, causing them to melt at the point of contact. A metal bead is deposited, joining the two pieces of metal together.

Armature A support upon which clay or plaster may be used in building or fashioning an image.

Atomizer An instrument used to spray fixative, paint, or other fine liquid particles. It is usually used to apply fixative to pastel drawings.

Ball mill A machine with porcelain jars containing pebbles and water. It is used to grind and mix glazes.

Ball peen A machinist hammer with a hemispherical head opposite the face. It is often used for planishing or chasing metal.

Balsa A light wood used for floats, model airplanes, and simple constructions.

Banding wheel A free-running wheel that makes it possible, in making pottery, to keep the clay image constantly rotating in concentric motion.

Bauhaus A school, basically experimental in nature, which originated in Dessau, Germany. Its principles of education through vision and the sense of touch were later transferred to America, and are continually being felt in the field of art education.

Bentonite A soft, porous rock of volcanic origin, used as a glaze ingredient.

Bicarbonate of soda A chemical reagent (Na_2CO_3) used to harden plaster surfaces.

Binder An adhesive that holds together two elements—such as glue and paste.

Bisque An unglazed clay that has been fired in a kiln.

Blow torch A torch used for heating metals which operates on gas or other fuels.

Brazing A process by which two pieces of metal are fused together by an alloy such as brass, hard lead, or nickel silver.

Bull chisel A metal stone carving chisel with a striking head similar to the bushhammer.

Bushhammer A metal stone carving (crushing) hammer with a striking head divided into rows of metal points or teeth referred to as boucharde.

Butterflies Clay supports made of small pieces of cross blocks of wood attached to string or wire. Their purpose is to support and keep large masses of clay from sagging away from the armature.

Calcimine A white or colored wash made of glue, whiting, and water.

Calipers A measuring compass.

Cameo A relief carving cut in one layer with another layer serving as a background.

Camouflage The art of disguising by changing its original form and color by design.

Carborundum An abrasive in solid or powder form which comes in fairly coarse- to fine-grain forms. It is used for grinding, graining, and polishing.

Carpenter's bench A solid bench usually constructed with two-inch planks and four- by four-inch supports.

Carver's vise A vise with smooth or leather gripping plates used to hold pieces of wood while they are being carved.

Centrifugal casting The act of casting, usually silver, in a rapidly revolving mold.

Ceramics A clay, glass, or enamel that has been fired in a kiln.

Checks Tiny cracks in a glaze caused by an inherent disagreement between clay body and the glaze, or incorrect firing.

Cire perdue Usually referred to as the "lost wax" process of casting bronze. A method in which bronze replaces melted wax.

Coelanaglyphic relief An inverse bas relief (intaglio) in which the images do not project beyond the surface plane.

Coil method The process of building pottery or sculpture by using coils of clay. The coils are placed one on top of another and wedged together.

Collage A form of painting-sculpture in low relief made by pasting an array of objects or parts of objects on a flat surface, creating new forms and portraying new meanings.

Coniferous Trees that remain verdant; evergreens such as pines and cedars.

Construction A nonobjective form of sculpture of recent origin usually made of wood, wire, string and/or plastic, as well as other materials, which defines space and sublimates mass.

Crackle (See checks.)

Craze (See checks.)

Damp box A metal-lined container used to retain the moisture in clay.

Deciduous Trees that lose their leaves at maturity, usually during the fall season.

Dextrin A substance such as corn syrup and homemade starch used to cause clay to harden and strengthen.

Diorite An igneous rock, granular in character.

Embossing The act of decorating by using a raised surface.

Emery paper An abrasive with a paper backing, used to remove scratches from metal in the polishing process.

Enamel A form of fused glass composed of a flux and various metal oxides which give it an opaque or transparent coloring. It is available in powder, lump, or tread forms.

Engobe Colored liquid clay used over a clay body for decoration.

Exogenous Hardwood trees having a close grain. These trees have flat leaves. The chestnut and oak are good examples.

Feldspar A nonplastic substance that increases the porosity of clay body before firing. During firing it functions as a flux.

Firing The process of subjecting clay pieces to extreme heat in order to harden and make them more durable and permanent.

Fixatif A clear liquid having the quality of fixing or making permanent such substances as chalk, charcoal, and pastels. It may also be used as a protective coating for clean surfaces.

Flat chisel A metal tool with a cutting edge that is short and blunt. It is used in the surface-finishing stage of carving.

Flint In powdered form it serves the purpose of silica (SiO_2) and is used to obtain a desired degree of shrinkage.

Flux A substance used to promote fusion, especially of metals and clay bodies. When used in soldering or brazing it prevents oxidation of metal where joining is to occur.

Frisket A wax or rubber latex coating applied on ceramicware to serve the purpose of a stencil, preventing glaze, colored slip, or engobe from coming into contact with the clay body. It is removed before the firing process.

Frog A tool that has two prongs, much like a slingshot, with a thin piece of wire stretched taut between them. It is used to cut clay.

Gesso A mixture of parchment, size, and whiting, or rosin, glue, linseed oil, and whiting used to decorate low relief or on flat wooden surfaces. It can be cut into and modeled and carved.

Glaze A vitreous or glasslike surface coating placed over a clay piece.

Glost A kiln packed with glazed ware to be glaze-fired.

Glycerine A colorless, odorless solvent ($C_3Hs(OH)_2$) used in the arts.

Gouge A wood chisel with a curved cutting edge.

Green clay A term applied to dry clay before it has been fired.

Grog A clay that has been fired and ground into a powder. It is used in unfired clay to make it porous and help prevent it from shrinking, cracking, and warping.

Guard-line (See scoreline.)

Gum arabic A gum composed of calcium, magnesium, and potassium of arabic acid, used to make an adhesive.

Gum tragacanth An adhesive used to hold light particles or pieces of metal together during a fusing or soldering process.

Gypsum A calcium dehydrate ($CaSO_42H_2O$) from which plaster of Paris is made.

Hew The process of forming or shaping by cutting with an ax or other sharp instrument. The process may apply to shaping clay by tearing away large areas with one's hands.

Hopi One of a Pueblo tribe of Shoshonean Indians which originally lived on the mesas of North Central Arizona.

Igneous Rocks or stones formed by fire. They are the softer more porous varieties such as basalt, diorite, and obsidian.

In-the-round A free-standing sculpture, one that is designed to be viewed on the basis of 360 degrees.

Jade A green, gem stone used in making jewelry and small statues.

Jig A piece of equipment used to hold a small piece of wood sculpture while it is being carved. It helps to protect the desk or table.

Kachina The Hopi spirit of the ancient. Symbolized by wooden images painted in many bright colors and at times ornamented with feathers.

Kick wheel A potter's wheel that is foot-driven. Its function is to spin moist clay while it is being formed into pottery.

Kiln A high-temperature furnace in which clay, glass, and enamel pieces are fired.

Lapidary A power-driven machine used for cutting, grinding, and polishing stones used in jewelry making.

Leaf A thin sheet or lamina of any substance, especially gold, silver, or aluminum. It is used to decorate wood and clay sculpture as well as other materials.

Leather-hard A term used to describe clay that is partially dry.

Linseed oil An oil extract of flax seed. It is used to condition wood sculpture.

Mallet A hammerlike instrument made of metal that is used to apply pressure on woodcutting tools. It is usually made of beechwood, lignum vitae, or hickory.

Mat glaze A glaze with a dull but even finish. It has an eggshell-like texture.

Media Plural for medium.

Medium Material used by the artist such as stone, wood, plaster, and clay. May also refer to an instrument.

Mica An elastic mineral silicate that readily separates into very thin sheets. It varies from colorless to yellow, silver, brown, green, red, and black.

Mobile A three-dimensional construction loosely linked together in such a way that its parts are movable and can be set in motion by the slightest currents of air.

Montage A design or sculpture resulting from the overlapping and superimposing of heterogeneous elements such as wood, plastics, paper, and metal into a relief.

Mortise tenon A piece of wood with holes, tied with a string. This perforated wood is capable of gripping and supporting clay.

Oil stone A whetstone used with oil for sharpening wood carving tools and such other tools as scrapers and bruins.

Onyx A veined gem with layers of different colors.

Oscillation The act of moving back and forth like a pendulum. One of the principles of motion found in a mobile sculpture.

Overglaze Color that is applied for decorative purposes after the ware has been glazed.

Oxides A binary compound of oxygen with color used to add color to glazes and clays.

Paleolithic The Old Stone Age period, which began in approximately 100,000 B.C.

Papier mâché A substance made of paper pulp mixed with sizing, glue, resin, clay, and the like. It is used as a sculptural medium.

Parent metal The actual, natural, or main metal or metals used in creating a work of sculpture. It differs from an alloy, which is used as an adhesive or for finishing purposes.

Patina The colors formed on metal by natural causes or artificial means of using chemicals. It is also a term in coloring other materials such as wood, clay, and plaster by using other color media.

Peephole A small hole approximately one-half inch in diameter in the wall of a kiln. It is used to peep through to see how the firing is progressing.

Plaster bat A flat, round slab of plaster—usually an inch to two inches thick —used to dry the clay as well as a working surface for images and pottery.

Plaster of Paris A calcined gypsum cement used as a sculptural medium. May also be used for making molds and bats.

Plasticine A nonhardening clay composed of tallow, pumice, powdered sulphur, earth clay, and varied plasticizers such as petroleum derivitives or linseed oil.

Pneumatic A method of using compressed air or electricity to operate drills and chisels with a minimum expenditure of muscular energy.

Point A stone-cutting tool with a sharp point used in the roughing-out stage of carving to remove the large masses of stone.

Pointing machine An instrument used to measure the character of a three-dimensional image for the purpose of reproducing it in a more permanent medium.

Polychromy The application of many colors on a work of art for decorating purposes.

Porphyry An igneous rock with feldspar crystals embedded in a dark background.

Potassium alum A plaster hardening agent.

Presymbolic A stage in creative development in which children explore, discover, and express their emotions. It preceeds the producing concepts of "things." It is sometimes referred to as the scribble or manipulative stage.

Pugged clay A wet, processed-earth clay used by potters for sculptural and pottery purposes.

Pumice A powder made from volcanic ash used as an abrasive for polishing purposes.

Putty powder A very gentle abrasive used on marble and other soft substance.

Pyrometer An instrument for measuring temperatures that go beyond the range of mercurial thermometers. It is used on ceramic and enamel kilns.

Pyrometric cones Elongated pyramidal forms made of clay bodies to react to certain kiln temperatures. They are used to indicate when a kiln has reached the desired temperature.

Quartz A form of igneous rock having an excess of silica in crystalline masses. It can be found colorless, transparent, and in many colors ranging from pale pink to black.

Rasp A metallic abrasive tool with fine, sharp, pyramidal teeth.

Relief A form of sculpture in which the image projects from a background. A relief may be low (basso), medium (mezzo), high (alto), or flat (stiacciato).

Reed A long, thin strand of flexible wood primarily used in making baskets.

Riffler A fine curved file or rasp used to refine the surface of wood or stone; especially useful for working in a notch or depression.

Rouge A substance, in either paste or solid form, used to polish metals, especially silver or gold.

Router An instrument that scoops out or cuts away the surface of wood as well as other materials.

Scoreline An incision made at the end of an intended cut or wood carving to prevent going beyond said point.

Sculp-metal An aluminum paste compound which hardens when it comes into contact with air. It can be modeled, carved, chiseled, filed, and sanded.

Seasoning A process of properly drying wood so that the physical strength is increased preventing undue checking and warping before and after carving.

Sedimentary Rocks formed by solidification of subterranean masses. They are usually in the more compact, durable variety: travertine, slate, and certain marbles.

Set A process of allowing a medium such as cement or plaster to harden.

Sgraffito A form of decoration made by cutting through an outer layer of colored clay coating, allowing the basic clay underneath to show.

Sieve A screen through which finer particles of pulverized substance pass, separating them from the larger particles.

Silica A substance made of silicon dioxide (SiO_2). Sand is the most common form of silica.

Slab method The process of building pottery or sculpture by using flat slabs of clay.

Slip A dry clay that has been pulverized to a fine powder and then mixed with water to a heavy creamlike consistency.

Sloyd knife A small, sharp knife used primarily in wood carving. It can also be used for carving plaster of Paris, soap, and fire brick.

Solder A metallic alloy used in its melted form to join metallic surfaces together. Sculptor's solders are usually composed of lead or silver.

Solvent A substance capable of dissolving another substance, such as turpentine or alcohol.

Stabile A three-dimensional construction designed with a variety of materials for the purpose of defining space. Unlike the mobile, it is devoid of motion.

Stain A water- or oil-base vehicle used to impregnate wood for the purpose of giving it a discoloration.

Stilts Props made of refractory clay, used to support glazed ware so it will not come into contact with the floor or shelves of the kiln

Tallow The fat extract of sheep used in making soap and candles.

Temper The act of bringing metal (chisel) to a desired consistency or degree of toughness by heating and sudden cooling.

Tempera An opaque, water-base paint, commonly used in the elementary schools.

Terra cotta A term meaning earth that has been baked.

Thaumatrope A round piece of paper with a drawing of a bird on one side and on the other a cage. A string was attached to the two opposite ends and when spun it gave the illusion of the bird in the cage.

Third-dimension A quality of depth.

Throwing The act of creating pottery on a potter's wheel.

Tongs An instrument used to hold objects that are too hot to hold with the hand or objects that are being placed within an area of intense heat.

Toothed chisel A tool similar to the flat chisel, except that its cutting edge consists of a row of serrated, pointed teeth.

Tragacanth A gum made from Asiatic herbs which swells up in water and is used in the arts.

Tuff A stratified rock composed of volcanic detritus.

Undercut Portion of a sculptural piece being cast which prevents the easy removal of the mold.

Underglaze A ceramic coloring applied to a green or bisque clay piece before a clear glaze is applied.

Varicolored Having various, diversified colors.

Veiner A V-shaped tool used to make an incision into wood and other materials.

Vibratile A combination of a stabile and a mobile. The vibratile is constructed of resilient materials, especially metal rods and wire. Its motions are not as diverse or perpetual as those of the mobile. Vibration is the principal movement.

Vitrify The act of fusing clay into a glasslike form by means of intense heat.

Wedging The act of throwing clay against a resistant object in an attempt to remove the air pockets and thoroughly homogenize the clay so that it has a uniform consistency.

Wedging board A boxlike construction with a solid plaster base and taut piece of wire. Clay is cut by the wire and thrown with some force onto the plaster for the purpose of mixing the clay, giving it an even consistency throughout.

Zoetrope A strip of figures inside a cylinder that are animated as the cylinder is revolved.

Bibliography

Ames, Edward S., *Psychology of the Religious Experience.* New York: Houghton Mifflin Company, 1910.

Argiro, Larry, *Mosaic Art Today.* Scranton, Pa.: International Textbook Co., 1961.

Baranski, Matthew, *Mask Making.* Worcester, Massachusetts: The Davis Press, 1954.

Bassett, Kendall T., Thurman, Arthur B., and Victor D'Amico, *How to Make Objects of Wood.* New York: The Museum of Modern Art, 1951.

Batchelder, Marjorie, and V. L. Comer, *Puppets and Plays: A Creative Approach.* New York: Harper and Row, Publishers, Inc., 1956.

Bates, Kenneth, *Enameling: Principles and Practice.* Cleveland: The World Publishing Company, 1951.

Baxter, William T., *Jewelry, Gem Cutting and Metalcraft.* New York: McGraw-Hill Book Company, 1950.

Beaumont, Cyril, *Puppets and Puppetry.* London: The Studio Publications, 1958.

Becker, Edith C., *Adventures with Scissors and Paper.* Scranton, Pa.: International Textbook Co., 1959.

Betts, Victoria B., *Exploring Papier-Mâché.* Worcester, Mass.: The Davis Press, 1955.

Binns, Charles F., *The Potter's Craft* (3rd ed.). New York: D. Van Nostrand Co., Inc., 1948.

Bittermann, Eleanor, *Art in Modern Architecture.* New York: Reinhold Publishing Corp., 1952.

Clark, Carl Dame, *Molding and Casting.* Baltimore, Md.: The Standard Arts Press, 1946.

Cox, Doris, and Barbara Warren, *Creative Hands* (2nd ed.). New York: John Wiley & Sons, Inc., 1951.

D'Amico, Victor, *Creative Teaching in Art,* rev. ed. Scranton, Pa.: International Textbook Co., 1953.

———, and others, *Art for the Family.* New York: Museum of Modern Art (distrib. Simon and Schuster, Inc.), 1954.

Della Seta, Alessandro, *Religion and Art.* London: Adelphi Terrace, 1914.

Duncan, Julia Hamlin, in collaboration with Victor D'Amico, *How to Make Pottery and Ceramic Sculpture, 20 Graded Projects.* New York: Museum of Modern Art (distrib. Simon & Schuster, Inc.), 1947.

Eliscu, Frank, *Sculpture: Techniques in Clay, Wax, Slate.* Philadelphia: Chilton Co., 1959.

Epstein, Jacob, *Let There Be Sculpture.* New York: G. P. Putnam's Sons, 1940.

Erdt, Margaret, *Teaching Art in the Elementary School.* New York: Holt, Rinehart & Winston, Inc., 1954.

Franke, L. E., and W. L. Udell, *Handwrought Jewelry.* New York: Taplinger Publishing Co., 1962.

Frazer, James G., *The Golden Bough.* New York: The Macmillan Company, 1911.

Gaba, Lester, *Soap Carving: Cinderella of Sculpture.* London: The Studio Ltd.; New York: The Studio Publications Inc., 1939.

Gill, Eric, *Sculpture, An Essay on Stone Cutting.* Sussex, England: St. Dominic's Press, 1924.

Gross, Chaim, *The Technique of Wood Sculpture.* New York: Vista House Publishers, 1957.

Gross, Fred, *How to Work with Tools and Wood.* New York: Pocket Books, Inc., 1955.

Grosse, Ernst, *The Beginning of Art.* New York: Appleton-Century-Crofts, 1898.

Hirn, Vrjo, *The Origins of Art.* London: Macmillan and Co., Ltd., 1900.

Hoffman, Malvina, *Sculpture Inside and Out.* New York: W. W. Norton & Company, Inc., 1939.

Home, Ruth M., *Ceramics for the Potter.* Peoria, Ill.: Charles A. Bennett Co., Inc., 1952.

Hughes, Toni, *How to Make Shapes in Space.* New York: E. P. Dutton & Co., Inc., 1956.

Itten, Johannes, *Design and Form: The Basic Course at the Bauhaus,* trans. John Maass. New York: Reinhold Publishing Corp., 1964.

Karaz, Mariska, *Adventures in Stitches, A New Art of Embroidery;* and *More Adventures, Fewer Stitches.* New York: Funk & Wagnalls Co., 1959.

Keiler, Manfred L., *The Art in Teaching Art.* Lincoln, Neb.: University of Nebraska Press, 1961.

Kennard, Joseph Spencer, *Masks and Marionettes.* New York: The Macmillan Company, 1935.

Kenny, John, *Ceramic Sculpture.* New York: Greenberg, 1949.

———, *Complete Book of Pottery Making.* New York: Greenberg, 1949.

Knudsen, Estelle H., and Ethel M. Christensen, *Children's Art Education.* Peoria, Ill.: Charles A. Bennett Co., Inc., 1957.

Krum, Josephine R., *Hand-Built Pottery.* Scranton, Pa.: International Textbook Co., 1960.

Leach, Bernard H., *A Potter's Book.* London: Faber & Faber, Ltd., 1940.

Lord, Lois, *Collage and Construction in the Elementary and Junior High Schools.* Worcester, Mass.: Davis Publications, 1958.

Luquet, Georges H., *The Art and Religion of Fossil Man.* New Haven, Conn.: Yale University, 1930.

Lynch, John, *How to Make Mobiles.* London: Shames & Hudson, 1953.

———, *Mobile Design.* New York: Studio Publications, Inc., 1955.

Martin, Charles F., in collaboration with Victor D'Amico, *How to Make Modern Jewelry.* New York: Museum of Modern Art (distrib. Simon and Schuster, Inc., 1949.

Mattil, Edward L., *Meaning in Crafts,* (2nd ed.). Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1965.

Merten, George, *The Hand Puppets.* New York: Thomas Nelson & Sons, 1957.

———, *The Marionette.* New York: Thomas Nelson & Sons, 1957.

Miller, Josephine V., *Paper Sculpture and Construction.* Peoria, Ill.: Charles A. Bennett Co., Inc., 1957.

Mosele, Spencer, Pauline Johnson, and Hazel Koenig, *Crafts Design.* Belmont, Cal.: Wadsworth Publishing Co., Inc., 1962.

Mumford, Lewis, *Art and Technics.* New York: Columbia University Press, 1952.

Nelson, Glenn C., *Ceramics.* New York: Holt, Rinehart & Winston, Inc., 1960.

Noma, Seiroku, *The Art of Clay.* Tokyo: Bijutsu Shuppan-sha, 1954.

Norton, Frederick H., *Ceramics: An Illustrated Primer.* Garden City, N.Y.: Hanover House, 1960.

Perry, Evadna K., *Art Adventures with Discarded Materials.* Los Angeles: Wetzel Publishing Co., 1933.

Petrie, Marie, *Modeling.* Peoria, Ill.: Charles A. Bennett Co., Inc., 1955.

Read, Herbert, *A Concise History of Modern Sculpture.* New York: Frederick A. Praeger, Inc., 1964.

———, *The Art of Sculpture.* New York: Pantheon Books, Inc. (for the Bollinger Foundation, Inc., Bollinger Series XXXV, 3), 1956.

Rhodes, Daniel, *Clay and Glazes for the Potter.* New York: Greenberg, 1957.

Rich, Jack C., *The Materials and Methods of Sculpture.* New York: Oxford University Press, Inc., 1947.

Ritchie, Andrew Carnduff, *Sculpture of the Twentieth Century.* New York: Museum of Modern Art (distrib. Simon and Schuster, Inc.), 1952.

Riley, Olive, *Masks and Magic.* New York: Studio Publications, Inc., 1955.

Rood, John, *Sculpture in Wood.* Minneapolis: University of Minnesota Press, 1950.

———, *Sculpture with a Torch.* Minneapolis: University of Minnesota Press, 1963.

Röttger, Ernst, *Creative Clay Design.* New York: Reinhold Publishing Corp., 1963.

———, *Creative Paper Design.* New York: Reinhold Publishing Corp., 1961.

———, *Creative Wood Design.* New York: Reinhold Publishing Corp., 1961.

Roy, Vincent A., *Ceramics.* New York: McGraw-Hill Book Company, 1959.

Schinneller, James, *Art: Search and Self-Discovery.* Scranton, Pa.: International Textbook Co., 1961.

Schnier, Jacques, *Sculpture in Modern America.* Berkeley: University of California Press, 1948.

Seymour, Charles, Jr., *Tradition and Experiment in Modern Sculpture.* Washington, D.C.: American University Press, 1949.

Slobodkin, Louis, *Sculpture: Principles and Practice.* Cleveland: The World Publishing Company, 1949.

Spearing, Herbert Green, *The Childhood of Art.* New York: Holt, Rinehart & Winston, Inc., 1912.

Sweeney, James Johnson, *Henry Moore.* New York: Museum of Modern Art (distrib. Simon and Schuster, Inc.), 1946.

Travers, Ralph, *How to Make Professional Moulds and Castings.* Boston: Plastic Service Associates, 1952.

Upton, John, *Art of Woodcarving.* Princeton, N.J.: D. Van Nostrand Co., Inc., 1958.

Valentiner, Wilhelm R., *Origins of Modern Sculpture.* New York: Wittenborn and Co., 1958.

Von Neumann, Robert, *Design and Creation of Jewelry.* Philadelphia: Chilton Co., 1961.

Vogt, Von Ogden, *Art and Religion.* Boston: Beacon Press, 1960.

Weiss, Harvey, *Clay, Wood, and Wire.* New York: William R. Scott, Inc., 1956.

Wiener, Louis, *Hand-Made Jewelry.* New York: D. Van Nostrand Co., Inc., 1948.

Winebrenner, Kenneth D., *Jewelry Making as an Art Expression.* Scranton, Pa.: International Textbook Co., 1953.

Wilenski, Reginald H., *The Meaning of Modern Sculpture.* London: Faber & Faber, Ltd., 1932.

Wright, Frank Lloyd, *The Living City.* New York: Horizon Press, 1958.

Zorach, William, *Zorach Explains Sculpture.* New York: American Artists Group, 1947.

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